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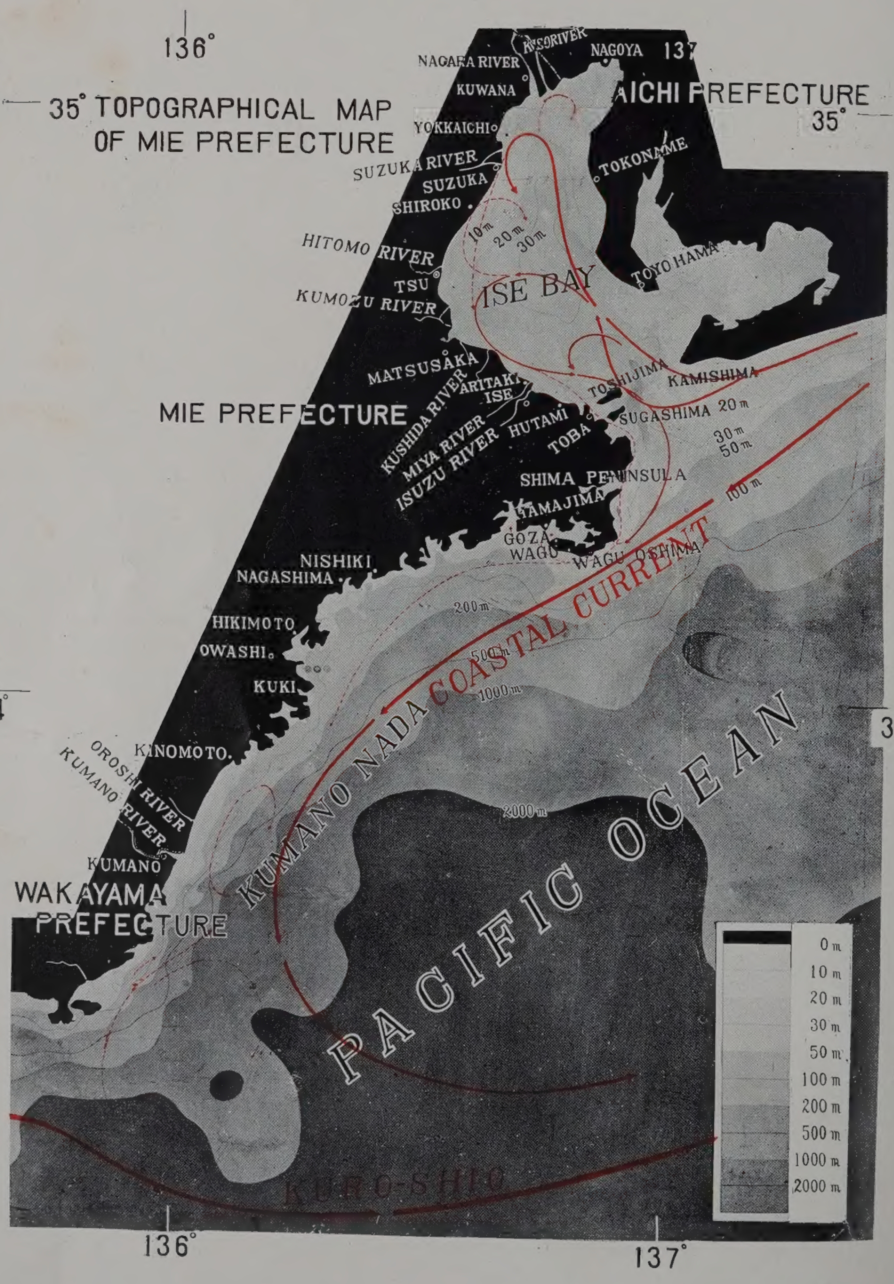
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Descriptions and Figures of Marine Fishes obtained at Mie Prefecture, the Middle of Honshu, Japan*

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INTRODUCTION

Mie Prefecture, situated in the middle of Central Japan (Lat. 33°45′–35°15′ N, Long. 135°50′–136°57′ E) is 159.82 kilometers in length from north to south and extends over 5,763 square kilometers.

From the topographycal points of view, mountain ranges border the western area down to south, and its eastern part is the fertile Ise Plain spreading from north to south, with the mountain ranges in the background and many rivers irrigating through and pouring into Ise Bay. In the area, there are mountains close to the coast line. Thirty-three rivers of various sizes flow into Ise Bay bring off aboundant nutritions over to the regions between the mouth of Kiso River and Futami. Of these rivers, Kiso, Nagara and Ibi have much broader widths, and the large quantity of those fresh waters gives greater effects to the water of Ise Bay than the other rivers which mostly pour into the northern water of the bay. The area, northwardly situated above the line passing Futami, Mie Prefecture and Tokoname, Aichi Prefecture, is characterized by the inland sea water, not being directly effected by the open sea water. The western Ise Bay, with its maximum depth of 80 meters, and the mean depth of 30 meters in its middle part, forms a breeding ground of fishes and other marine resources. The water between Futami and Kowa is seemingly subject to the effect of "Kuro-shio" (warm current), but bears the characteristics of the quiet inland sea owing to the uneveness of the facing coast line, and the inflow of the aboundant fresh waters of several rivers. Accordingly, this region gives a suitable ground for the rapid growth of marin products. These facts may induce the conditions of nice grounds for pearl culture. The southern sea coast from Nishiki downward directly faces the deep-sea, "Kumano-nada", and is washed by the warm current all through the year. A very narrow continental shelf, which is inhabitable for many tropical and subtropical fishes, extends along the sea coast.

From these facts above mentioned, we conclude that the oceanographical characters of sea water around Mie Prefecture indicate four characteristic features: first, the inland sea (mostly Ise Bay), second the mixture of inland sea and open sea, third the real open sea and last deep sea. With these peculiar environments the fish fauna is exhibited in plenty, more than 500 species. But many of these fish are known only to a few professional ichthyologist who have published in some brief notes on them.

As for the early studies in Mie Prefecture, systematic works on marine fishes were

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taken in hand by S. TANAKA (1913) and followed by K. UI (1929). After these basic works, Y. OKADA and K .SUZUKI (1951) made a list of fish fauna of this region. And a catalogue of fishes of Owashi and its adjacent region was published by T. HANAI (1956). Especially the deep-sea fishes in "Kumano-nada" were paid attention by K. MATSUBARA and others. They have described out 20 new species since 1936. These are chronologically listed up as follows:

1936. *Davidijordania abei* MATSUBARA, *Percis matsuii* MATSUBARA
1937. *Hoplichthys fasciatus* MATSUBARA, *Parapterygotrigla multiocellata* MATSUBARA
1938. *Yarrella elongata* (MATSUBARA)
1940. *Chlorophthalmus acutifrons* HIYAMA
1943. *Leuroglossus lineatus* MATSUBARA, *Neoscopelus microchir* MATSUBARA, *Itatius microlepis* MATSUBARA, *Coelorhynchus hubbsi* MATSUBARA, *Lionurus japonicus* MATSUBARA, *L. abei* MATSUBARA
1951. *Rhynchocymba nystromi xenica* (MATSUBARA et OCHIAI), *Samariscus latus* MATSUBARA et TAKAMUKI
1952. *Bembrops filodorsalis* OKADA et SUZUKI, *B. curvatura* OKADA et SUZUKI, *Xiphasia matsubarai* OKADA et SUZUKI, *Eulophias owasii* OKADA et SUZUKI
1953. *Acropoma hanedai* MATSUBARA, *Carapus owasianus* MATSUBARA

But no author has ever produced a comprehensive work in which the full description of all species is included.

The present illustrated monograph has been expected to fill this particular need, and will be published in two or three parts in the course of the following two years.

Class **Chondrichthyes**

Two subclasses, Elasmobranchii and Holocephali are included in the present class; upper jaws free from the skull, teeth usually separate, and normally five to seven gill-openings. In the Holocephali the upper jaw is a part of brain case, the teeth in each jaw are united to form a bony plate, and there is only one external gill-opening.

Key to Subclasses

a^1 Five to seven pairs of gill-openings, each of the latter opening separately to exterior; dorsal fin or fins, and spines if present, rigid, not erectile; skin with or without dermal denticles; teeth numerous; upper jaw or palatoquadrate cartilage not fused to cranium, although it may be locally attached to it; rostral cartilage fused to cranium; vertebral centra more or less clearly differentiated, and the notochord more or less constricted segmentally; at least some of vertebrae of trunk region with articulated transverse ribs; the two halves of pelvic girdle fused into a single bar; anus and urogenital canals discharge into a common cloaca; males without prepelvic or frontal tenacula. ...... **Elasmobranchii**

a^2 Only four pairs of gill-openings, with only one opening to the exterior on each side of head; dorsal fin and spine erectile; skin in adult naked, without dermal denticles; teeth represented by six pairs of grinding plates; upper jaw or palatoquadrate cartilage fused with cranium; rostral cartilages articulated to cranium, not fused; no vertebral centra, and the notochord not constricted segmentally; ribs lacking; the two halves of palvic girdle separate, no cloaca, the urogenital aperture being distinct from anus and posterior to it; males with an erectile prepelvic tenaculum, and usually with a frontal

tenaculum on the head also. ·· **Holocephali**

Subclass Elasmobranchii

These fishes have cartilaginous bone, mainly soft, but part may be hardened by calcification. Gill-openings separate, normally slit-like. Intestine with a spiral valves. Males with claspers, attached to the pelvic fins. No ordinally scales, skin usually with denticles of some form on dermal plates, mostly small.

Key to Orders

a[1] Gill-openings at least partly lateral; edges of pectoral fins not attached to sides of head anterior to gill-openings; upper margin of orbit free from eyeball (eyelid free). ·················· **Lamnida**

a[2] Gill-openings confined to ventral surface; edges of pectoral fines attached to sides of head anterior to gill-openings; upper margin of orbit not free from eyeball (no free eyeball).······**Rajida**

Order Lamnida

Sharks of large size, with the body stout, the mouth wide, with large teeth, and the caudal fin lunate, the two lobes being not very unequal, the upper lobe strongly bent upward; caudal peduncle with the keel on each side; gill-openings wide, all in front of the pectorals, entirely lateral, not extending under the throat; first dorsal large; pectorals large; ventrals moderate; second dorsal and anal very small; a pit at the root of the caudal; spiracles minute or absent.

Key to Suborders

a[1] Anal fin present.

- b[1] 6 or 7 gill-openings, one dorsal. ·· **Hexanchina**
- b[2] Only 5 gill-openings; 2 dorsals, rarely 1 dorsal.
  - c[1] Dorsal fines preceded by stout spines; teeth toward center of mouth in each jaw markedly different from those toward its corners. ······································ **Heterodontina**
  - c[2] Dorsal fins not preceded by spines; teeth toward center of mouth of same basic type as those toward its corners. ·· **Lamnina**

a[2] No anal fin.

- d[1] Snout of only moderate length, without lateral teeth or barbels.
  - e[1] Trunk subcylindrical; eyes lateral; anterior margins of pectorals not overlapping gill-openings. ··· **Squalina**
  - e[2] Trunk much flattend dorsoventrally; eyes dorsal; anterior margins of pectorals far overlapping gill-openings. ··· **Squatinina**
- d[2] Snout greatly elongate, as a narrow beak, armed on either side with sharp teeth, and with a long fleshy barbel. ·· **Pristiophorina**

Suborder Hexanchina

Six or seven gill-openings. Dorsal fin single, without spine. Anal fin present. Mesopterygium of pectoral fin reaching the anterior margin of fin; no radials on propterygium.

Family **Hexanchidae**

Body elongated, somewhat depressed anteriorly, tapering towards the caudal fin.

Head depressed, oblong and semi-oval or semi-elliptical above, with the snout projecting. Either six or seven gill-openings; margins of all gill-openings widely interrupted at throat; eyes submedian or anterior, without nictitating membranes; spiracles small, present. Mouth inferior, large, arched in front, no labial fold. Upper teeth sharp, with slender, curved, primary cusps; lower teeth blade-like, quadrate or triangular, their margins with several small cusps. Lower jaw with six large comb-like teeth on each side, besides the smaller posterior teeth. Caudal fin with well marked subterminal notch its axis raised but little; inner margins of pelvics either separated or briefly united posterior to cloaca; no precaudal pits; dorsal fin posterior to pelvics; lower jaw with either large or rudimentary labial furrows; no upper labial furrows, clasper of mail largely enclosed by a leaf-like expantion of the pelvic fin, its axial cartilage small, simple distally, and attached to the basipterygial cartilage of fin by two small connecting segments. Development ovo-viviparous.

Genus *Heptranchias* RAFINESQUE, 1810

Body elongate, partly fusiform, compressed. Head tapering forward, or broad. Snout broad or narrow and produced. Eye lateral, large .Mouth large, cleft long and wide, angle with labial fold and deep groove toward gill-opening. Teeth dissimilar, compressed, laterals each with large primary cusp, denticulate on its inner edge and with four or more smaller cusps, increasing in number posteriorly. Small symphyseal tooth on lower jaw. Gill-openings seven. Spiracle small, far behind and above eye. Dorsal small, behind ventrals. Caudal long.

1. *Heptranchias perlo* (BONNATERRE). "Edoabura-zame"

Le perlon BROUSSONET, 1780 Mém. Acad. Roy., p. 668.

Squalus perlo BONNATERRE, 1788, Ichth, p. 10.

Squalus cinereus GMELIN, 1789, LINN. Syst., vol. 1, p. 1497. –SCHNEIDER, 1801, Bloch Ichth., p. 132. –RISSO, 1810, Ichth Nice, p. 24

Heptranchias cinereus RAFINESQUE, 1810, Caratteri, p. 13. –GILL, 1861, Ann, N. Y. Lyc., vol. 7, p. 404.

Monopterinus cinereus BRAINVILLE, 1816, Bull. Soc. Philom., p. 121. –1830, Poiss. Fr., p. 80.

Notidanus cinereus CUVIER, 1829, Reg. Anim., vol. 2, p. 390. –BONAPARTE, 1841, Icon. Fauna Ital., Pesci. –GÜNTHER, 1870, Cat. Fishes Brit. Mus., vol. 8, 398.

Heptanchus cinereus MÜLLER et HENLE, 1841, Plagios., p. 81, pl. 35, f. 3. –DUMÉRIL, 1865, Elasm., p. 432. –MOREAU, 1881, Poiss. France, vol. 1, p. 339, f. 57.

Heptranchias deani JORDAN et STARKS, 1901, Proc. Cal. Acad. Sci., ser. 2, vol. 2, p. 348. –JORDAN et FOWLER, 1903, Proc. U. S. Nat. Mus., vol. 26, p. 595.

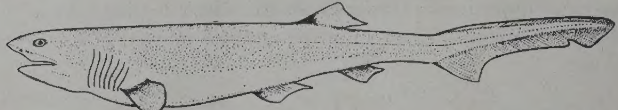


Fig. 1 ***Heptranchias perlo*** (BONNATERRE), (×ca. 1/18) from MATSUBARA

Body very elongated, more or less terate. Snout produced, compressed above, narrow and roundly pointed. Eyes large, no nictitating membrane. Spiracle small, opening midway between eye and first gill-opening. Seven gill-openings, which become progressively smaller backward, all lie entirely in front of the pectoral base. Mouth on the ventral side of the snout, having a long groove at each corner. Teeth in the upper jaw long, sharply pointed, hooked backward, without lateral cusps; no median tooth in the upper jaw; the median tooth at the symphysis of the mandible flanked by two or three cusps on each side; each of the four teeth on each mandibular ramus a serrated cuttting edge composed of six or more cusps. Single dorsal fin inserted slightly anterior to the anal fin. Caudal fin a very elongated, with a notch near the tip of its lower lobe. Pectoral fin small. Body dark grey on the back, paler on the belly. Development ovo-viviparous.

Locality: Mie Prefecture — Owashi, Nishiki.

Distribution: Southern Japan, Mediterranean Sea, Indian Ocean.

Suborder Heterodontina

Anal fin present; two dorsal fins with well developed spins; only five gill-openings, the last three or four over base of pectoral. Nostrils present. No nictitating membrane. Inner margins of pelvics entirely separate, posterior to cloaca. Vertebral column completely segmented throughout its length, its axial canal much contracted in the region of the centra, which are fully differentiated, and notochord greatly constricted segmentally in centra; vertebral centra with internal calcareous lamellae radiating from a central ring. Heart valves in only two rows. Claspers of males projecting freely from pelvics. Development oviparous; egg cases horny with spiral flanges, but without tendrils.

Family **Heterodontidae**

Body elongate; obtusely trihedral, gradually tapering backward; head high, with the forehead declivous, and little prominent. Mouth rather narrow, the upper lip devided into seven lobes, the lower with a fold; dentition similar in both jaw, small obtuse teeth in front, and the lateral teeth molar-like and enlarged. Nostrils confluent with the mouth. Gill-openings five. Dorsal fins two, and each provided with a strong spine. Caudal fin usually notched at tip.

Only one genus, *Heterodontus* BLAINVILLE.

Genus *Heterodontus* BLAINVILLE, 1816

Body elongate, thick and heavy anteriorly, and the tail tapering. Head thick, oblong, broad. Snout bluntly rounded, rather long, and protruding. Eyes small, high, with the ridges above more or less prominent. No nictitating membrane. Mouth rather small and narrow; teeth small and obtuse in front, in the young pointed, and provided with three to five cusps; the posterior teeth molar-like, twice as broad as long, and arranged in oblique series, one series being formed by much larger teeth than those in the other series. Spiracles small, a short distance from the lower part of the eye. Gill-openings rather narrow. Scales small, sometimes cruciform. First dorsal opposite the space between pectorals and ventrals; second dorsal in advance of anal; pectorals very large and below gill-openings; caudal fin moderate, more or less

bent upward.

2. *Heterodontus japonicus* (DUMÉRIL). "Neko-zame"

Heterodontus philippi var. japonica DUMÉRIL, 1870, Hist. Nat Poiss., vol. 1, p. 424; Japan.
Cestracion japonicus MACLAY et MACLEAY, 1883, Proc. Linn. Soc. N. S. Wales, vol. 8, p. 428, pl. 20; Japan.
Heterodontus japonicus STEINDACHNER, 1898, Reise Aurora, p. 224; Japan.
Heterodontus zebra BLEEKER, 1854, Verh. Bat. Gen., vol. 26, p. 127; Japan (not to GRAY).

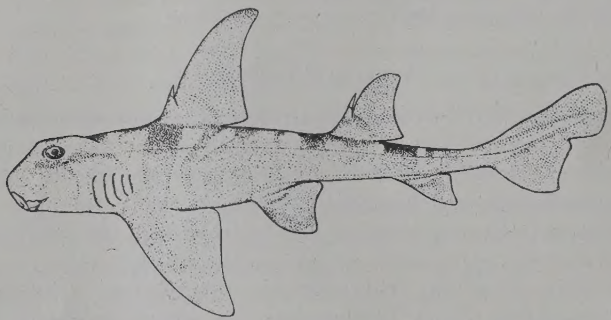


Fig. 2 ***Heterodontus japonicus*** (DUMÉRIL), (× 1/2) from MATSUBARA

Body very elongate, more or less rounded, though somewhat depressed in front; tail compressed, broader than deep. Snout produced, compressed above, flat, roundly pointed; eye large, anterior, lateral, superior; mouth large, triangular; lips not especially thick; corners of mouth forming a long groove equal to one half length of exposed dental margin of mandible. Teeth in upper jaw sharp, long, pointed, hooked backward, without lateral cusps; teeth in mandible four on each ramus, each teeth with a serrated cutting edge composed of six or more cusps; tongue not free from floor of mouth. Nostrils large, about midway on snout below, between its tip and front of eye; interorbital width convexly fllattened. Spiracles small, superior, and about midway between eye behind and gill-opening. Gill-opening large, broad, becoming progressively smaller behind, all entirely in front of root of pectoral. Boby very finely roughened. Dorsal fin small, its greater portion before origin of the anal. Anal low, its base long. Pectorals small. Ventrals low, base long, nearer origin of anal than origin of pectoral. Caudal very long, lower lobe deep in front, then very narrow till near end, where a terminal notch is formed. Caudal peduncle compressed, somewhat triangular in cross section, flattened above. Color in spirits dark gray brown above and on the upper parts of fins, below pale or whitish.

Locality: Mie Prefecture — Owashi, Tsu, Shima.

Distribution: Southern Japan, Southern Korea.

Suborder Lamnina

Two dorsal fins without spines. Five gill-openings. Jaws hyostylic. Palato-quadrate not articulated or loosely articulated to the skull. Mesopterygium not reaching the anterior margin of pectoral fin. Radials of propterygium one to several. Notochord constricted. Vertebral centra asterospondylic. Rostral cartilages typically of three elements. Axial cartilage of the claspers dorso-ventrally.

Key to Families

a[1] At least 1/2 of base of first dorsal posterior to origin of pelvics.
  b[1] Caudal not lunate, not very large, not bent upward; mouth below. .... **Scyliorhinidae**
  b[2] Caudal lunate, large, bent upward; mouth nearly anterior. ....**Rhincodontidae**
a[2] Base of first dorsal terminates over, or (usually) well anterior to origin of pelvics.
  c[1] Head greatly expanded laterally. .... **Sphyrnidae**
  c[2] Head of normal shape, not expanded laterally.
    d[1] Caudal fin lunate, its axis steeply raised. .... **Lamnidae**
    d[2] Caudal fin not lunate, its axis raised only moderately at most.
      e[1] Caudal fin occupies nearly 1/2 total length, or even more. .... **Alopiidae**
      e[2] Caudal fin occupies considerably less than 1/2 total length.
        f[1] Upper edge of nictitating fold continuous with edge of eyelid, or even arising outside latter posteriorly, although enclosing it anteriorly; teeth low, rounded or with three or more cusps, usually in mosaic arrangement, several series functional simultaneously in sides of jaws as well as in front................**Triakidae**
        f[2] Upper edge of nictitating membrane arises far within edge of eyelid posteriorly, as well as anteriorly, teeth blade-like with one cusp only, not in mosaic arrangement, usually not more than one or two series functional in sides of jaws simultaneously. .... **Carcharhinidae**

Family **Scyliorhinidae**

Dorsal fins two, both rather small, without spines, the first more or less behind the ventrals; anal fin present, usually before the second dorsal; caudal fin rather long, usually with a basal lobe; the tail not keeled and not bent upward. Spiracles present, close behind eye; no nictitating membrane; gill-openings small, the last one above the root of the pectorals. Mouth usually broad, with small teeth, several series being in function; teeth small, each with a median cusp and one to four small cusps on each side; nostrils near mouth, not confluent with it, sometimes provided with cirri. Gill-openings five, nearly equidistant. Mucous pores above head numerous, especially on lower side of snout. Egg cases large, quadrate, with prehensile tubes at the angles.

Key to Genera

a[1] Origin of first dorsal over, or usually behind, origin of pelvics.
  b_1 Scales of caudal peduncle and dorsal margin of caudal fin conspicuously larger than body scales; arranged in several longitudinal series.
    c[1] Nostrils far from mouth, the distance from their inner angles to corners of latter about 1/2 as great as horizontal diameter of eye; posterior margin of nostril not lobed; snout long, thin, its mucous pores not conspicuous. .... **Galeus**
    c[2] Nostrils close to mouth, although entirely separate from latter; distance from inner angle of nostril to corner of mouth not more than 1/4 as great as horizontal diameter of eye; posterior margin of nostril with a well developed lobe; snout short and thick, its mucous pores very prominent. .... **Parmaturus**
  b[2] Scales of caudal peduncle and dorsal margin of caudal fin moderate size. ...... **Scyliorhinus**
a[2] Origin of first dorsal anterior to origin of ventrals; labial folds arroud corner of mouth; teeth tricuspid. .... **Calliscyllium**

Genus *Galeus* RAFINESQUE, 1810

Two dorsal fins, the first originating over rear part of pelvics; denticles along

dorsal margin of anterior part of caudal enlarged and modified in shape, forming a distinct crest, bounded below by a narrow band of naked skin on either side; lower margin of caudal peduncle with or without a similar crest of enlarged denticles; nostrils far from mouth, their anterior margins without barbels, their posterior margins not expand as flaps; snout long, thin, labial furrow extending from lower jaw around corner of mouth to upper jaw, the upper lip not closing outside lower at corner of mouth; upper eyelid not closing outside lower of eye; fourth gill-opening close in front of pectorol, the fifth over pectoral; teeth alike in the two jaws, with long pointed median cusp and one to three smaller cusps on each side; tail sector of trunk considerably longer than body sector; caudal axis raised but slightly; anal much longer than second dorsal, separated from caudal by a considerable interspace.

3. *Galeus eastmani* (JORDAN et SNYDER). "Yamori-zame"

Pristiurus eastmani JORDAN et SNYDER, 1904, Smith. Misc. Coll., vol. 45, p. 230, pl. 60; Izu (Japan).
Galeus eastmani FOWLER, 1930, Proc. 4th (1929) Pacific Sci. Congr., Java, p. 485



Fig. 3 ***Galeus eastmani*** (JORDAN et SNYDER), (× ca. 2/5) from MATSUBARA

Body slender, elongate; head small, narrow; snout rather acutely pointed. Gill-openings equidistant, fifth shortest and above pectoral base. Spiracle level with and close behind eye, its width equals its distance behind eye. Scales trilobed, minute, each with central keel. Upper edge of tail with keel beginning eye diameter behind second dorsal base and extends posteriorly space somewhat greater than head. Origin of first dorsal about opposite last two fifths in anal length, anal length equals head. Brownish above. Free margins of dorsal and anal white.

Locality: Mie Prefecture — Kumano-nada.

Distribution: Deep sea of Izu and Kochi (Japan).

Genus *Parmaturus* GARMAN, 1906

Nostrils close to mouth, although entirely separate from latter; distance from inner angle of nostril to corner of mouth not more than one fourth as great as horizontal diameter of eye; posterior margin of nostril with a well developed lobe; snout short and thick, its mucous pores very prominent.

4. *Parmaturus pilosus* GARMAN. "Imori-zame"

Parmaturus pilosus GARMAN, 1906, Bull. Mus. Comp. Zool., vol. 46, p. 204; Japan.

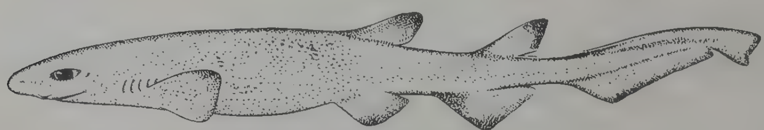


Fig. 4 ***Parmaturus pilosus*** GARMAN, (× ca. 1/3) from MATSUBARA

Body elongate, slender. Head broad, snout broad. Tail long, compressed; caudal fin not deep. Nostrils large. Mouth large in width equal to two and one third times the length, or one half times the length of the snout; labial folds short. Teeth compressed, asymmetrical; cusps sharp. Eye large, three fourths as long as the snout. Spiracles small, near the eye, in width equal to the distance from the orbit. Gill-openings small. Dorsal fins equal, middle of the base of the first dorsal in the middle of the total length. Base of the second dorsal equal to the length of the snout from the eyes. Pectorals short. Origin of ventrals little forward of that of the dorsal. Anal base about twice as long as that of the ventral. Scales minute, nearly erect, slightly bent backward, with a strong median cusp at each side of the base of which there is a much smaller one. Upper surface warm brown, lower lighter, fins darker with blackish ends, inside of mouth and throat dark.

Locality: Mie Prefecture — Kumano-nada.

Distribution: Deep sea of Sagami-nada (Japan).

Genus *Scyliorhinus* BLAINVILLE, 1816

Body shorter than tail. Head short. Snout blunt and short. Mouth large; labial fold on lower jaw. Teeth in many rows, each tooth with median larger cusp, and from one to several lateral cusps. Nostrils distinct from mouth, or, in species in which hind nasal valve cirroid, with rudimentarly nasoral groove. Front nasal valves not confluent across internarial spaces, cirri absent or rudimentary. Gill-openings small, last above pectoral. Spiracles small, close to corner of eye. Dorsals and anal small, anal longest. First dorsal above or behind ventral bases. Caudal short. Ventrals of male more or less concrescent above claspers.

5. *Scyliorhinus torazame* (TANAKA). "Tora-zame"

Catulus torazame TANAKA, 1908, Jour. Coll. Sci., Tokyo, vol. 23, p. 6, f. 7; Misaki, Sagami (Japan).

Scyliorhinus rudis PIETSCHMANN, 1908, Anz. Akad. Wiss. Wien, vol. 10, p. 2, –1908, Sitzb, Akad. Wiss. Wien, 117, vol. p. 699, pl. 1, f. 3. –REGAN, 1908, Ann. & Mag. Nat. Hist., ser. 8, vol. 1, p. 457.

Halaelurus rudis TANAKA, 1911, Fishes of Japan, vol. 1, p. 13, f. 12.

Halaelurus torazame TANAKA, 1912, Fishes of Japan, vol. 5, p. 87.

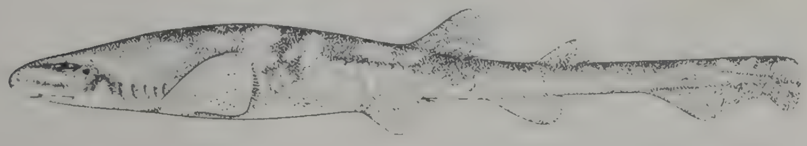


Fig. 5 ***Scyliorhinus torazame*** (TANAKA), (× ca. 3/10) from MATSUBARA

The elongated body of this little shark is compressed before the fiirst dorsal, especially on the head. The top of the head and the belly are flat and broad. The horizontally elongate eye has no nictitating membrane. The spiracles open immediately behind the eyes. The labial folds are developed only on the lower jaw. The tricuspid teeth are of equal size on the two jaws. The last two gill-openings lie above the base of the round pectoral fin. The origin of the first dorsal is above and posterior to the base of the pelvic fin; the second dorsal is inserted a little anterior to the posterior end of the anal base. The anal fin is horizontal, never curved up. Scales rough, with one to three sharp cusps, a median keel and diverging striae.

Locality: Mie Prefecture — Owashi.

Distribution: Hokkaido, Honshu (Japan); Korea, Philippines.

Genus *Calliscyllium* TANAKA, 1912

Anterior margin of nostril not expanded as a well developed barbel. Spiracle moderately large.

6. *Calliscyllium venustum* TANAKA. "Hyō-zame"

Calliscyllim venustum TANAKA, 1912, Fishes of Japan, 10, p. 171, pl. 46.



Fig. 6 ***Calliscyllium venustum*** TANAKA, (×ca. 1/5) from MATSUBARA

Origin of second dorsal about over origin of anal or behind it, its tip or posterior to tip of latter; labial furrows very short. Anterior margin of nostril close to mouth; near tip of first dorsal a little anterior to origin of pelvics; tips of pelvics anterior to origin of second dorsal by a distance considerably longer than base of second dorsal.

Locality: Mie Prefecture — Owashi, Hikimoto.

Distribution: Tokyo Bay, Sagami Bay, Kyushu (Japan); China Sea.

Family **Rhincodontidae**

Enormous size, with robust body and broad, blunt head. Caudal bent well up, with notch at base above, and a keel each side on peduncle which is the hinder end of a body ridge. Small spiracle present. Mouth large with many small conical recurved teeth. Eye small, no nictitating membrane. Only one genus *Rhincondon* SMITH, with one species.

Genus *Rhincodon* SMITH, 1829

Teeth conical, very small. Characters otherwise included above.

7. *Rhincodon typus* SMITH. "Jinbei-zame"

Rhincodon typus A. SMITH, 1829, Zool. Jour., vol. 4, p. 443.

Rhincodon typicus MÜLLER et HENLE, 1841, Plagios., p. 77, pl. 35, f. 2. –A. SMITH, 1849, Afr. Pisces, pl. 26. –DUMÉRIL, 1865, Elasm., p. 428. –GÜNTHER, 1870, Cat. Fishes Brit. Mus., vol. 8, p. 396. –HALY, 1883, Ann. Mag. Nat. Hist., ser. 5, vol. 12, p. 48. –THURSTON, 1884, Bull. Madras Mus., no. 1, pl. 3A. –REGAN, 1908, Proc. Zool. Soc. Lond., p. 353. –GÜNTHER, 1910, Südsee Fishe, vol. 3, p. 486.

Micristodus punctatus GILL, 1865, Proc, Acad. Nat. Sci. Philadelphia, p. 117. –JORDAN et GILBERT, 1883, Bull. U. S. Nat. Mus., vol. 16, p. 32. –JORDAN et EVERMANN, 1896, Bull. U. S. Nat. Mus., vol. 47, p. 52.

Rhinodon pentelineatus KISHINOUYE, 1901, Zoll. Anz., p. 694.

Rhineodon typicus JORDAN et FOWLER, 1903, Proc. U. S. Nat. Mus., vol. 26, p. 626.

A very large species, attaining a length of more than 30 feet. Head depressed; snout broad, subtruncate; body cavity more than half of the total lentgh. Eye small, lateral, near the angle of the mouth, lower lid without a fold. Spiracle small, behind the eye. Nostrils at the end of the snout, near the lip; anterior valves widely separated, reaching the teeth, without cirri. Mouth wide, anterior, transverse, with labial folds on both jaws; upper fold elongate, lower short. Teeth very small, subconical, sharp, numerous. Gill-openings very wide, hindmost narrower, hindmost two above the

pectoral. Gill arches with long rakers serving as strainers for small prey. Pectorals large, broad, falciform with sharp angles and concave hind margin. Dorsals unequal, hinder angels produced; anterior dorsal large, posterior margin deeply concave, nearly in the mid total length. Second dorsal small, distant from first more than length of base of latter. Anal smaller than second dorsal, and originating below the hinder half of its base. Ventrals small; origin below hinder portion of first dorsal base. Tail with keel at each side of pedicel; with notch at origin of fin. Caudal large, vertebral section raised, subcaudal lobe well developed. Purplish to reddish brown profusely sprinkled with small spots and streaks of white; lower surfaces light reddish brown.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Cosmopolitan species in Temperate and Tropical regions.

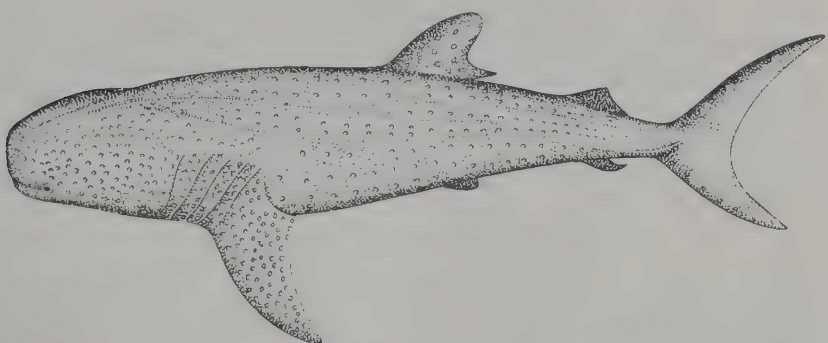


Fig 7. ***Rhincodon typus*** SMITH, from BEAN

Family **Sphyrnidae**

Head kidney shaped or "hammer" shaped from the extention of its sides, the nostrils being anterior and the eyes on the sides of the "hammer"; mouth crescent-shaped, under the "hammer". The teeth of both jaws similar, oblique, each with the outside near the base. No spiracles; last gill-opening over the pectorals; first dorsal and pectorals large, the dorsal nearer pectorals than ventrals; second dorsal and anal small; a pit at the root of the caudal; caudal fin with a single notch towards its tip, its lower lobe developed. Spiracles absent. Nictitating membrane present.

Genus *Sphyrna* RAFINESQUE, 1810

Head truely "hammer" shaped, the anterior, lateral, and posterior margins distinct; nostrils near the eye, the openings confluent with a groove, which extends along most of the head.

8. *Sphyrna zygaena* (LINNÉ). "Shumoku-zame"

Squalus zygaena 1758, LINNÉ, Syst. Nat., 10th ed., p. 243; Europe, America.

Body fairly long and slender, not very compressed. Teeth rather oblique, outer edges nearly straight, notched, serrated only in the young. Width of head about twice its length; first dorsal large; second quite small, smaller than anal; pectorals rather large; color gray.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Temperate and Tropical regions of Japan, Pacific, Atlantic, Mediterranean.

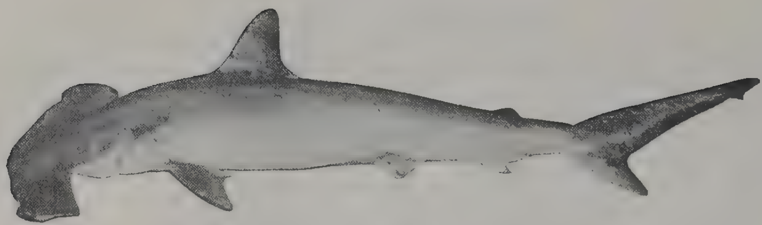


Fig. 8 ***Sphyrna zygaena*** (LINNÉ), (× 1/10) original

Family **Lamnidae**

Body stout, large, mouth wide, with large teeth, and the caudal fin lunate, the two lobes not very unequal, the upper lobe strongly bent upward; caudal peduncle with a strong keel on each side; gill openings wide, all in front of the pectorals, entirely lateral, not extending under the throat; first dorsal large; pectorals large; ventrals moderate; second dorsal and anal very small; a pit at the root of the caudal; spiracles minute or absent.

Genus *Isurus* RAFINESQUE, 1810

Snout rather long and pointed; first dorsal large, inserted, entirely behind pectorals, nearly midway between pectorals and ventrals; pectorals large; second dorsal and anal very small; caudal peduncle slender; teeth long, lanceolate, with sharp, entire cutting edges and no basal cusps.

9. *Isurus glaucus* (MÜLLER et HENLE). "Ao-zame"

Oxyrhina glauca MÜLLER et HENLE, 1841, Plagios., p. 69, pl. 29, -SCHLEGEL, 1850, Jap. Pisces, p. 302. -DUMÉRIL, 1865, Elasm., p. 409.



Fig. 9 ***Isurus glaucus*** (MÜLLER et HENLE), from JORDAN et EVERMANN

Snout long, pointed; teeth in four rows, very long, flexuous, without denticles at base. Spiracles very small. First dorsal inserted well backward, midway between pectoral and ventral, scarcelv longer than high, its upper angle rounded. Color dark blue, white below.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Middle and Southern Japan, Cosmopolitan.

Family **Alopiidae**

Body moderately elongate, snout rather short; mouth crescent-shaped; teeth

equal in both jaws, flat, triangular, not serrated; third tooth of the upper jaw on each side much smaller than the others; gill-openings moderate, the last one above the root of the pectorals; no nictitating membrane; spiracles just behind eye, minute or absent; first dorsal large, midway between pectorals and ventrals; second dorsal and anal very small;caudal fin exceedingly long, about as long as the rest of the body, a pit at its root, a notch on the upper lobe near its tip, lower lobe moderately developed; no caudal keel; ventrals rather large pectorals very large, falcate.

Genus *Alopias* RAFINESQUE 1810

Trunk slightly compressed. Snout subconical, short, blunt. Nostrils transverse. Mouth crescent-shaped. Teeth compressed, triangular, with two rooted bases and without serrations. Eyes large, pupil vertical. Spiracles small, behind the eyes. Gill-openings moderate, hindmost above pectorals. Pectorals subfalciform. First dorsal large; second dorsal and anal small. Caudal peduncl compressed; caudal fin very long, half or more of the total lengh; subcaudal lobe produced.

10. *Alopias pelagicus* NAKAMURA. "Onaga-zame"

Squalus vulpes GMERIN, 1788, Syst. Nat., 1. p. 1496; Mediterranean.



Fig. 10 ***Alopias pelagicus*** NAKAMURA, from JORDAN, TANAKA et SNYDER

Boby more or less roughened, thickest before dorsal fin; back regularly arched from above pectorals to end of snout, and gradually decreasing in size posteriorly to caudal. Head short, bluntly conical; snout blunt, eye rather large; mouth horse-shoe shaped, teeth about 22+22/19+19. Spiracles very small or wanting. Last gill-openings above or slightly in front of pectorals. First dorsal high, triangular, somewhat higher than its base is long, slightly slender toward its summit, superior angle rounded; second dorsal similar in shape, but much smaller; anal small, placed behind second dorsal, which it resembles; pectorals long, wide, emerginate, with small process behind, ventrals wider than high, nearest first dorsal; caudal nearly as long or longer than body, composed of three distinct lobes, one small, triangular, at under side of tip, a second long and low, extending along upper side of tail, and a third short and broad, at lower base of tail. Color, slate-blue above, beneath soiled white, marked with obsolete bluish spots; pupils a longitudinal slit, edged with golden.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Middle and Southern Japan, Formosa, Korea.

Family **Triakidae**

Two dorsal fins, the first much shorter than the caudal; its base terminating anterior to origin of pelvics; caudal less than one fourth of total length, not lunate, cau-

dal peduncle not flattened dorsoventrally or expanded laterly, with or without a precaudal pit above, but none below; sides of trunk, anterior to anal, without longitudinal ridges; snout not greatly elongate, or jaws widely protrusible; fifth gill-opening posterior to origin of pectoral; nostril either separate from much or connected with latter by a groove; spiracles present or absent; lower eyelid with a longitudinal fold externally, but without internal nictitating membrane; teeth small, rounded, or with three to four distinct cusps; several series functional along entire length of jaw; dermal denticles ovate, lanceolate or tridentate; head of normal shape and not widely expanded laterally. Rostral cartilages three, united terminally; most of the pectoral on metapterygium; meso and propterygia much smaller; heart valves in three rows.

Key to Genera

a[1] Teeth low, rounded, or with only slightly sinuous cutting edge. .... **Musterus**
a[2] Teeth somewhat compressed, with three to five pointed cusps. .... **Triakis**

Genus *Mustelus* LINK, 1790

Nostrils entirely separate from mouth; teeth numerous, alike in the jaws, low rounded, or with somewhat sinuous cutting edge, in mosaic arrangement, several rows functional; corners of mouth with a strongly marked labial furrow on each jaws; caudal with well marked subterminal notch; dorsals, anal and pelvics with their posterior corners considerably produced and their posterior margins moderately concave; origin of anal below second dorsal; rear end of base of first dorsal considerably anterior to origin of pelvics.

Key to Species

a[1] Covered with small white spots above lateral line. .... **M. manazo**
a[2] Not covered with small white spots above lateral line. .... **M. griseus**

11. *Mustelus manazo* BLEEKER. "Hoshi-zame"

Mustelus manazo BLEEKER, 1854, Verh. Bat. Gen,. vol, 26. p, 126; Nagasaki (Japan).



Fig. 11 ***Mustelus manazo*** BLEEKER, (×1/12) original

Snout markedly pointed, long. Forty-five to fifty rows of rounded rather flattened in a pavement in upper, about forty similar in lower jaw. Pupil of eye rounded. Sometimes white spots.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Japan, Formosa, Korea, China, Indo-China, Arabian Sea, Natal.

12. *Mustelus griseus* PIETSCHMANN. "Shiro-zame"

Mustelus griseus PIETSCHMANN, 1908, Anz. K. Akad. Wiss. Wien, vol. 10, p. 132; Japan.

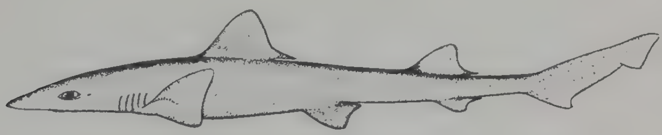


Fig. 12 ***Mustelus griseus*** PIETSCHMANN, (× 1/5) from MATSUBARA

Resembled to *Mustelus manazo*; but differes in the following characters: No whitish spots over surface of body, origin of first dorsal situating just middle point between snout and origin of second dorsal, usually pectorals not reaching under origin of first dorsal.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Coasts of Japan.

Genus *Triakis* MÜLLER et HENLE, 1838

Body compressed, elongate; mouth large, crescent-shaped, with well developed long labial folds; teeth moderate, numerous, similar in both jaws, each with a longer median cusp, and one or two smaller ones on each side; eyes small, with nictitating membrane; spiracles small, behind the eyes; no pit at the root of the caudal; no lower lobe to the caudal; first dorsal opposite the space between the pectorals and ventrals. Color variegated, black and grey.

13. *Triakis scyllia* MÜLLER et HENLE. "Dochi-zame"

Triakis scyllium MÜLLER et HENLE, 1833, Plagios., p. 63, pl. vol. 26; Nagasaki (Japan). –DUMÉRIL, 1870, Elasm. p. 397 (after MÜLLER et HENLE). –JORDAN et SNYDER, 1900 Proc. U. S. Nat. Mus., p. 336; Tokyo.

Triakis scyllium GÜNTHER, 1870, Cat. Fish, vol. 8, p. 384 (after MÜLLER et HENLE), –ISHIKAWA, 1897, Prel. Cat., p. 62; Tokyo, Sagami (Japan).



Fig. 13 ***Triakis scyllia*** MÜLLER et HENLE, (× 1/10) from MATSUBARA

Body long, slender, back elevated, and tail compressed, tapering. Head depressed, flattened below, much broader than deep; snout in profile pointed, when seen from above very broadly rounded and flattened; eye small, lateral, with nictitating membrane; mouth very broad, crescent-shaped, not angular, so that it begins in front of eye and ends below middle; teeth small, numerous, sharp-pointed, tricuspid; labial fold at the corner of mouth on each side; nostrils large,on lower surface of head, nearer mouth than tip of snout; interorbital space broad, flattened. Spiracles small, directly behind

eyes. Gill-openings lateral, posterior above base of pectoral. Body entirely roughened, the pickles coarser above. First dorsal large, a little nearer origin of second dorsal than tip of snout, also nearer origin of pectoral than that of ventral; second dorsal midway between posterior base of first dorsal and anterior base of lower caudal lobe; anal well behind second dorsal; pectoral shorter than head, its posterior margin slightly emarginate, reaching beyond middle of space between its own origin and that of ventral; ventrals nearer origin of anal than posterior base of pectorals; caudal small, four and one fourth of total length. Caudal peduncle narrow, compressed above and beneath. Lateral line present along sides, superior. Color dark grey brown, with a number of scattered, indistinctly defined, blackish spots; lower surface of body pale; sides and lower portions of pectorals and ventrals grayish brown.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Shores of Southern and Middle Japan, Korea, China, Formosa, Southern Australia.

Family **Carcharhinidae**

Two dorsal fins, the first much shorter than the caudal, its base wholly anterior to margin of pelvics; caudal much less than one half of total length, with well marked subterminal notch, not lunate, but the lower anterior corner expanded as a definite lobe; caudal peduncle not strongly flattened dorso-ventrally or widely expanded laterally; precaudal pits more or less strongly marked; inner margins of pelvics entirely separate, posterior to cloaca, in both sexes; jaws not widely protrusible; fifth gill-opening over or posterior to denticles; nostrils entirely separate from mouth, their anterior margins without barbel; spiracles present or absent; eyes with well developed nictitating membrane within lower lid; labial furrows more or less developed, on one or both jaws; teeth blade-like, with only one cusp, only one row functional along sides of jaws, or two; head of normal shape, not widely expanded laterally; rostral cartilages three, united anteriorly; radials of pectoral mostly on metapterygium; meso- and propterygia separated by a foramen, at least in some cases; heart valves in three rows. Development either ovo-viviparous, or viviparous with well developed yolk-sac placenta.

Key to Genera

a[1] No serrations in both jaws, teeth without swollen bases. .... **Scoliodon**

a[2] Teeth all serrated, at least some or all on bases and cusps.

b[1] First dorsal near pectorals. .... **Carcharhinus**

b[2] First dorsal near ventrals. .... **Gliphis**

Genus *Scoliodon* Müller et Henle, 1837

Head rather wide and flattened. Snout rather elongate, not very pointed. No spiracles; triangular teeth with a deep notch on the outer margin below the sharp point; a pit at base of tail; first dorsal well in front of ventrals, much longer than second.

14. *Scoliodon walbeehmi* (Bleeker). "Hiragashira"

Carcharias (*Scoliodon*) *walbeehmi* Bleeker, 1856, Nat. Tyds. Ned. Ind., vol. 10, p. 353; Bintang.

Snout from front margin of mouth, more than distance of eye from gill-opening; a short labial groove at angle of mouth extending for a short distance on upper jaw as well as lower; distance be-

tween outer angles of nostrils equal to that of nostril from extremity of snout. Pectoral fin with posterior margin slightly concave and upper angle pointed, extending somewhat beyond origin of dorsal fin; first dorsal greyish. Twenty-four to twenty-eight triangular teeth with smooth edges in each jaw.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Southern and Middle Japan, Formosa, Korea, China, Indo-China, Philippines, West Indies, Pinang, Singapore, Ceylon, Indian Ocean, Natal.



Fig. 14 ***Scoliodon walbeehmi*** (BLEEKER), from DAY

Genus *Carcharhinus* BLAINVILLE, 1816

Body with little anal fin if any longer at base than second dorsal; without spiracles; midpoint of first dorsal nearer to axil of pectoral than the origin of pelvics; cusps of upper teeth regularly serrate; back with or without mid-dorsal ridge; caudal peduncle without lateral ridges, but with well developed upper precaudal pit; first dorsal subtriangular, first posterior angle more or less prolonged as a free corner; second dorsal and anal of approximately equal size and much smaller than first dorsal; pelvics quadrilateral; upper labial furrow very short; no lower labial furrow. Development viviparous.

15. *Carcharhinus gangeticus* (MÜLLER et HENLE). "Mejio-zame"

Carcharias (Prionodon) gangeticus MÜLLER et HENLE, 1841, Plagios., p. 39, pl. 13. –DUMÉRIL, 1865, Elasm., p. 359. –GÜNTHER, 1870, Cat. Fishes Brit. Mus., vol. 8, p. 367. –DAY, 1878, Ind. Fishes, p. 715, pl. 187. –STEINDACHNER, 1900, Denk. Acad. Wiss. Wein, vol. 70, p. 519.

Carcharias (Prionodon) japonicus SCHLEGEL, 1850, Jap. Pisces, p. 302, pl. 133. –JORDAN et FOWLER, 1903, Proc. U. S. Nat. Mus., vol. 26, p. 614.



Fig. 15 ***Carcharhinus gangeticus*** (MÜLLER et HENLE), (×ca. 1/7) from MATSUBARA

Head rather short and broad. Snout very short. Nostrils at the edge of the snout, nearly midway

in the pectoral length. Mouth large, labial fold very short. Eyes small. Origin of the first dorsal above end of pectoral base, length of base greater than its distance from the ventrals, upper angle blunt, hinder produced. Second dorsal base about half the length of that of first dorsal, about equal its distance from the caudal, origin little in front of that of the anal. Anal little smaller than the second dorsal, hind ends of bases opposed, angles sharp. Caudal large, subcaudal lobe prominent. Greyish, lighter beneath.

Locality: Mie Prefecture — Tsu, Owashi.

Distribution: Southern and Middle coasts of Japan, China, Philippines, Indo-China, West Indies, Indo, Arabia, Hawaii, Polynesia, New South Wales, South Australia.

Genus *Glyphis* Agassiz, 1843

Head rather wide, somewhat depressed, normal. Body fairly slender. Spiracles absent. Nictitating membrane present. A notch at base of tail above and below. Curved triangular teeth with serrated edges, bases broad.

16. *Glyphis glaucus* (Linné). "Yoshikiri-zame"

Squales glaucus Linné, 1758, Syst. Nat., 10th ed., p. 235; Europe.



Fig. 16 ***Glyphis glaucus*** (Linné), (×1/12) original

Body elongate; snout long and pointed. No lateral folds. The teeth on both jaws are serrated on their edges; those in the upper jaw are broader than those in below. No spiracles; the last gill-opening lies above the base of the large, sickle-shaped pectoral fin. The first dorsal slightly behind the middle of the body, near to the origin of pelvics than the origin of pectorals; second dorsal opposite the anal. Color grayish blue above, pale below.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Temperate and Tropical Regions of Pacific and Atlantic.

Suborder Squalina

No nictitating membrane to eyes. Vertebrae with calcareous lamellae arranged in a ring about central axis. Gill-openings before pectorals. Spiracles present. Dorsal fins two, with or without spines. No anal. Caudal bent upward, lower lobe little developed. Pectorals normal, not expanded or deeply notched.

Family **Squalidae**

Body subround; tail slender, compressed. Head depressed; rostral cartilage a trough-shaped process of the skull. Nostrils remote from the mouth. Mouth not greatly arched, with labial folds and a deep groove at each angle, slightly protrusible, upper jaws loosely articulated to the skull. No nictitating membrane. Spiracles present. Five gill clefts in front of each pectoral. Two dorsal fins, each proceeded

by a spine. No anal fin.

Key to Genera

a[1] Dorsal spines without lateral grooves; caudal not notched subterminally below. .... **Squalus**

a[2] Dorsal spines with lateral grooves. Notch below terminal part of caudal.

b[1] Upper teeth with only one cusp.

c[1] Snout in front of mouth considerably longer than from center of mouth to origin of pectorals; dermal denticles pitchfork-shaped, on tail slender pedicels. .... **Deania**

c[2] Snout in front of mouth considerably shorter than from center of mouth to origin of pectorals; dermal denticles at most only moderately dentate, on short broad pedicels, or sessile. ....**Scymnodon**

b[2] Upper teeth with several cusps. .... **Etmopterus**

Genus *Squalus* LINNÉ, 1758

Body rather slender. Mouth little arched, with a long, straight, deep, oblique groove on each side; no labial fold. Teeth rather small, all simple, equal in the two jaws, their points so much turned aside that the inner margin forms the cutting edge. Spiracles rather wide just behind the eye. Fins moderately developed, the first dorsal larger than the second, much in advance of the ventral fin, which are behind the middle of the body, although in advance of the second dorsal. Dorsal spines strong, not grooved. Tail scarcely bent upward.

17. *Squalus mitsukurii* JORDAN et FOWLER. "Tsuno-zame"

Squalus mitsukurii JORDAN et SNYDER, 1901, Annot. Zool., Japan, vol. 3, p. 129; Misaki, Sagami (Japan).



Fig. 17 ***Squalus mitsukurii*** JORDAN et FOWLER, (×ca. 1/5) from TANAKA

Body finely roughened, moderately elongate, tail tapering somewhat behind. Head broad, depressed, flattened above; snout pointed in profile, when viewed from above angular, tip rather broadly rounded, and upper surface flattened; eyes rather large, lateral, a little nearer tip of snout than first gill-opening; mouth very broad, slightly curved, a deep labial fold at each corner; lip thin; teeth moderate, forming a cutting edge in each jaw; nostrils rather large, inferior, while nearer eye than tip of snout they are nearer the latter than mouth; interorbital space is broad, very elevated, flattened more or less like upper surface of head. The spiracles large, directly behind eye. Gill openings in front of base of pectoral. Origin of first dorsal spine a trifle nearer tip of snout than that of second dorsal; first dorsal spine is three fifths height of fin; spine of second dorsal three fourths height of fin; pectorals large, smaller than head, reach beyond base of first dorsal, emerginate behind; ventrals nearer second dorsal than first; caudal broad, lower lobe rather long. Caudal peduncle rather long, with a pit at base above. Lateral line indistinct along side.

Locality: Mie Prefecture — Owashi.

Distribution: Southern Japan.

Genus *Deania* JORDAN et SNYDER, 1902

Scales minute; snout long, flattish. Each dorsal with a spine, each grooved, first spine small. Pectoral short, inner angle not produced. Teeth rather slender, more or less triangular. Dermal plates with caps each with three or four points.

18. *Deania eglantina* JORDAN et SNYDER. "Hera-tsuno-zame"

Deania eglantina JORDAN et SNYDER, 1902, Proc. U. S. Nat. Mus., vol. 25, p. 80, f. 2; Totomi Bay (Japan).

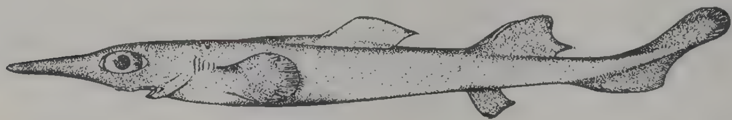


Fig. 18 ***Deania eglantina*** JORDAN et SNYDER, (×ca.1/3) from JORDAN et SNYDER

Body rather elongate, slender, scales each with short, bush-like spines. Head large, greatly depressed; snout long depressed, broad; eyes large, on lower side of snout laterally, about midway between tip of snout and eye; mouth rather large, opening below posterior part of eye; teeth small; spiracles rather large. Dorsal fin each with a spine, base of first a little behind tip of pectoral, rather short; second dorsal spine nearly as higher as fin, upper half exposed; pectorals about equal to snout; ventrals small; caudal elongate, lower lobe little produced. Color in spirits, uniform grayish brown.

Locality: Mie Prefecture — Owashi, Kumano-nada.

Distribution: Deep sea of Tokyo, Sagami and Suruga Bay (Japan)

Genus *Scymnodon* BOCAGE et BRITO CAPELLO, 1864

Teeth noticeably dissimilar in the two jaws. Inner corner of pecroral broadly rounded. Blades of dermal denticles with three to several ridges; with marginal teeth on posterior as well as anterior parts of trunk.

19. *Scymnodon squamulosus* (GÜNTHER). "Birōdo-zame"

Centrophorus squamulosus GÜNTHER, 1877, Ann. Mag. Nat. Hist., ser. 4, vol. 20, p. 433. -1887, Challenger Rep. Zool., vol. 22, p. 5, pl. 2, f. B.

Zameus squamulosus JORDAN et FOWLER, 1903, Proc. U. S. Nat. Mus., vol. 26, p. 633.

Scymnodon squamulosus REGAN, 1908, Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 48.



Fig. 19 ***Scymnodon squamulosus*** (GÜNTHER), (×3/4) original

Head depressed; snout bluntly rounded, length about equal the distance from the angles of the mouth to the first gill-opening. Nostrils oblique, at the end of the anterior third of the preoral length, with a small sharp process in the middle of the anterior valve. Mouth slightly arched, width less than the length of the snout, with a deep straight groove at each angle, and short labiai folds of which

the upper is longest, besides a fringed upper lip. Teeth smooth on the edges; upper more slender, nearly erect; lower broader, with a triangular cusp on a subquadrangular base, nearly erect at the symphysis, oblique toward the angle. Spiracles little above the level of the eye and about one length of the orbit farther back. Gill-openings small, upper ends in front of the pectoral. Pectorals small, inner angle blunt and not produced. Dorsal spines hardly produced beyond the skin. Base of first dorsal in the middle of the distance from the end of the snout to the caudal fin, length less than one fourth of the interdorsal space, fin narrow. Second dorsal much longer than the first, origin above the hind parts of the base of the ventrals, length of the base less than the distance from the caudal, hind angle acutely produced. Ventrals about equal to the second dorsal, ends of the fins below the hinder part of the base of the latter. Caudal short, in length about twice the greatest depth, terminal portion rounded, subcaudal separated from the terminal by a shallow notch, lobe weak, broadly rounded. Scale minute, tricarinate.

Locality: Mie Prefecture — Owashi, Kumano-nada.

Distribution: Deep sea of Sagami Bay and Kochi (Japan).

Genus *Etmopterus* RAFINESQUE, 1810

Body with dorsal spines largely exposed, arising at origin of fins; trunk slender, subcylindrical, the peduncle without lateral ridges or precaudal pits; snout in front of mouth is somewhat shorter than from front of mouth to origin of pectorals; upper and lower teeth unlike, the former with several cusps, the latter with only one cusp, deeply notched outwardly; dermal denticles ranging from bristle-like to scale-like; eyes and spiracles large; anterior margin of nostrils with a long, narrow-triangular lobe; a voluminus triangular pit at corner of mouth and a labial furrow on each jaw; dorsals triangular; origin of first dorsal posterior to tips of pectorals; second dorsal larger than first, its origin over or posterior to base of pelvics; caudal truncate, with well marked subterminal notch, but without definite lower anterior lobe; pectorals brush-shaped, their inner corners rounded; inner edge of anterior part of upper eyelid deeply pigmented; some of the species, perhaps all of them, with luminus organs.

20. *Etmopterus lucifer* JORDAN et SNYDER. "Hujikujira"

Etmopterus lucifer JORDAN et SNYDER, 1902, Proc. U. S. Nat. Mus., vol. 25, p. 79. –JORDAN et FOWLER, 1903, Proc. U. S. Nat. Mus., vol. 26, p. 634, f. 5. –SMITH et DADCLIFFE, 1912, Proc. U. S. Nat. Mus., vol. 41, p. 679. –TANAKA, 1912, Fishes of Japan, vol. 8, p. 133, pl. 36.

Spinax lucifer REGAN, 1908, Ann. Mag. Nat. Hist., ser. 8, vol. 2, p. 45.

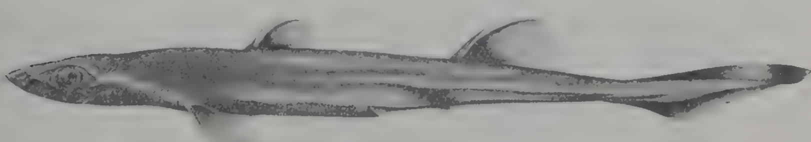


Fig. 20 ***Etmopterus lucifer*** JORDAN et SNYDER, (×2/3) original

Head tapering slightly from the spiracles forward. Snout produced, deep, broad to the nostrils; nostrils half way from the end to the eye, anterior valve acuminate at the outer edge. Eye large. Mouth little arched, width equal two thirds of the pectoral length. Teeth in the upper jaw with a strong and much longer median cusp at each side of the base of which is a pair of short cusps the

outer of which is very small. Gill-openings hardly as wide as the spiracles. Pectoral short, broad, not reaching the origin of the first dorsal. Origin of dorsal nearly midway from end of snout to the second dorsal. Spine of second dorsal twice as long as that of the first. Ventrals reaching little behind the spine of the second dorsal. Caudal two sevenths of the total length, separated at the terminal by a shallow notch. Scales with short setiform spines arranged in more or less regularly longitudinal series on the upper surfaces, the flanks, and below the tail. Back and flanks blackish brown, the brown separated from the black of the lower surfaces by longitudinal bands of whitish, probably becomming uniform black with age. Young specimens much lighter.

Locality: Mie Prefecture — Owashi, Kumano-nada.

Distribution: Deep sea of Atlantic coast of Japan, Philippines, East Indies, Natal.

Suborder Pristiophorina

No anal fin; two dorsal fins without spines; either five or six gill-openings, all of them anterior to origin of pectoral; snout greatly elongate, blade- or beak-like; each edge of snout and of head, anterior to mouth, armed with a row of sharp transverse, tooth-like structures and with a long fleshy barbel; tooth small, numerous, with one cusp, similar in front and sides of mouth, with several rows functional; trunk subcylindrical, except that head and snout are flattened dorso-ventrally; nostrils entirely separate from mouth; eye without nictitating membrane; spiracles present; inner margin of pelvics entirely separate posterior to cloaca; vertebral colmun completely segmented, with well developed centra, the notochord segmentally constricted correspondingly. Development ovo-viviparous.

Family **Pristiophoridae**

Body elongate, covered with fine, smoothish scales, forming shagreen; snout produced in a long, flat blade, with sharp teeth on each side projecting at right angles; a pair of barbels on lower part of snout near its middle; teeth small, each with a sharp cusp on a broad base; nostrils inferior, with conspicuous valves; eyes large, no nictitating membrane; spiracles large; pectorals rather large, distant from head; first dorsal in front of pectorals; second dorsal large; no dorsal spine; no anal fin; gill-opening moderate, all before pectoral; lower caudal lobe narrow.

Genus *Pristiophorus* MÜLLER et HENLE, 1837

Characters of genus included above. Only three species in the word.

21. *Pristiophorus japonicus* GÜNTHER. "Nokogiri-zame"

Pristiophorus japonicus GÜNTHER, 1870, Cat., Fishes Brit. Mus., vol. 8, p. 432, –ISHIKAWA et MATSUURA, 1897, Cat. Fishes, p. 61. –JORDAN et FOWLER, 1903, Proc, U. S. Nat. Mus., vol. 26, p. 639.

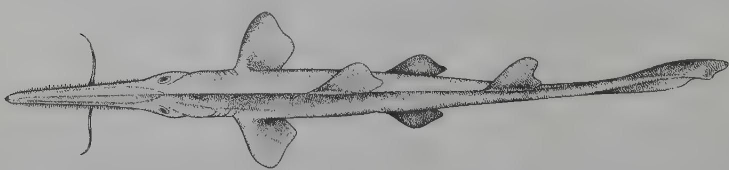


Fig. 21 ***Pristiophorus japonicus*** GÜNTHER, (× 1/3) original

Body elongate, moderately thick, finely roughened. Head small, except for elongate depressed snout, or saw, greatly depressed and flattened, both above and below; saw rather broad, thin, becoming narrow at tip, truncately rounded; each margin of saw a series of sharp teeth of uneven size, the larger with one, two or three smaller between; on lower marginal surface of snout a single series of small, backwardly hooked teeth, each at some distance apart; in lower surface of saw, near edges, a pair of flattened tentacles about equal in length to width of head in front of eyes; tooth on edge of saw become smaller posteriorly and extend halfway in space between eye and first gill-opening; mouth broadly obtuse below posterior part and behind eye; teeth small, pointed, in many rows in jaws; nostrils are trifle closer together than corners of mouth, nearer than tentacles; interorbital space more or less flattened; eye elongate, lateral. Spiracles very large, half the eye, placed directly behind its posterior margin. Gill-opening moderate, in front of base of pectoral. Origin of first dorsal nearer tip of caudal than tip of saw, nearer origin of ventral than that of pectoral, nearer posterior margin of eye than second dorsal; two dorsals are of about equal size, second with posterior part of its base midway between first dorsal and tip of caudal; pectorals large, broad, blunt ronded, nearer origin of dorsal than tip of saw; ventrals behind first dorsal and nearer origin of second dorsal than that of pectorals; caudal not very broad, upper lobe much broader than lower. Caudal peduncle rather long, thick, flattend above and below. A lateral keel along each side of tail from ventrals to caudal inferiorly. No pores in lateral lines. Color, pale gray-brown above; below, whitish.

Locality: Mie Prefecture — Owashi, Tsu,

Distribution: Japan.

Suborder Squatinina

No anal fin; two dorsal fins without spines; only five gill-openings, all anterior to origin of pectorals; snout not beak-like, without lateral teeth or cirri; teeth in front of mouth essentially similar to those towards its corner. The trunk very much flattened dorso-ventrally and expanded laterally anterior to cloaca, eye dorsal; anterior margins of pectorals extending forward past gill-openings and partly concealing them; pelvics also very broad, wing-like, their inner margins entirely separate posterior to cloaca; nostrils separate from mouth; spiracles, present, dorsal; eyes without nictitating membrane; vertebral column completely segmented throughout its length, its axial canal much contructed in the region of the centra, with the notochord greatly constricted segmentally in its passage through them; neural spines attached to dorsals. Heart valves in six to seven rows. Development ovo-viviparous.

Family **Squatinidae**

Snout very broad and short; eyes dorsal, without nictitating membranes: spiracles large; nostrils terminal, entirely separate from mouth, their anterior margins with barbels which are variously lobed; gill-openings lateral, but extending into lower surface; mouth protrusible at corners with well developed labial cartilage, nearly terminal but separated from front of snout by a deep transverse furrow; lower jaw with deep labial furrows near corners, teeth numerous, similar in the two jaws, with single thorn-like cusp on broad base, three or four series functional; caudal axis not raised at all above main axis of trunk; lower lobe of caudal longer than upper. Development ovo-viviparous; embryo with large yolk-sac. Only one genus is known.

Geuns *Squatina* RISSO, 1810

Head broadly rounded, with wing-like lateral expantions; spiracles behind eyes and at the same level as the latter; lips with well developed supporting cartilages, widely protrusible at corners of mouth but not centrally; anterior margins of pectorals expanded anteriorly as narrow shoulder-like extentions, lying below the lateral expantions of the side of the head, and more or less overlaping the pelvics rearward; pelvics origination anterior to posterior corners of pectorals; dorsal much smaller than pectorals or pelvics; caudal triangular, its posterior contour truncate or concave, its lower anterior margin longer than the upper anterior margin; caudal peduncle with a faintly longitudinal ridge along each side; claspers extend only a little beyond pelvics; dermal denticles on dorsal side conical, on broad, those on ventral side flat, with scale-like blades.

Key to Species

a[1] Fold along front of head with two lobes opposite and in front of corner of mouth. .... **S. nebulosa**

a[2] Fold along tront of head either nearly straight or at most obtusely rounded opposite corner of mouth. .... **S. japonica**

22. *Squatina nebulosa* REGAN. "Koro-zame"

Squatina nebulosa REGAN, 1906, Ann. Mag. Nat. Hist., ser. 7, vol. 18, p. 439.

Outer nasal flap with entire edges; inner flap with two nearly simple prolongation, the outer of which has a fringed lobed at its base. Folds at the side of the head forming two lobes with convex edges at each side, the second the larger opposite the angle of the mouth. Spiracles not quite so far as the eyes. Outer angle of tht pectoral much more than a right angle. Ventrals extending beyond the

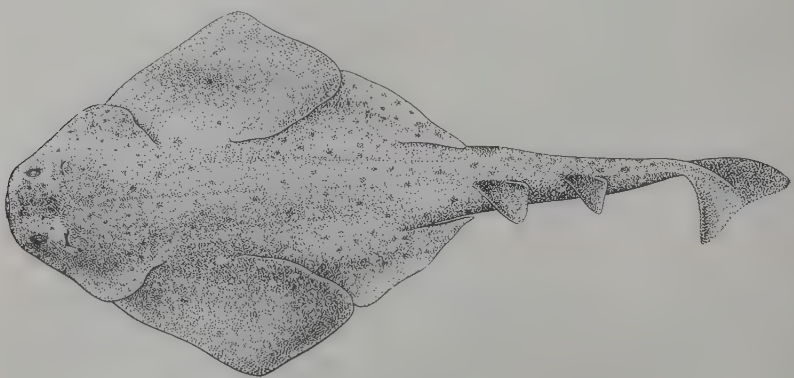


Fig. 22 ***Squatina nebulosa*** REGAN, (×3/10) original

origin of the first dorsal. Posterior edge of the supracaudal slightly emarginate; subcaudal nearly vertically truncate. Upper surface with small pointed denticles, each with three keels; no median series of enlarged denticles; small imbricated denticles at outer edges of paired fins, extending on to their lower surface and on the pectorals forming a strip about equal in width to the distance between eye and spiracle; denticles on lower surface of tail not extending forward to its base; lower surface of head and abdomen naked. Brownish, obscurely marbled with blakish, and with a few small rounded whi-

tish spots.

Locality: Mie Prefecture — Owashi.

Distribution: Southern and Middle of Japan.

23. *Squatina japonica* BLEEKER. "Kasu-zame"

Squatina japonica BLEEKER, 1857, Act. Soc, Sci. Ind. Neerl., vol. 3, p. 40. –JORDAN et FOWLER, 1903, Proc. U. S. Nat. Mus , vol. 26, p. 641.

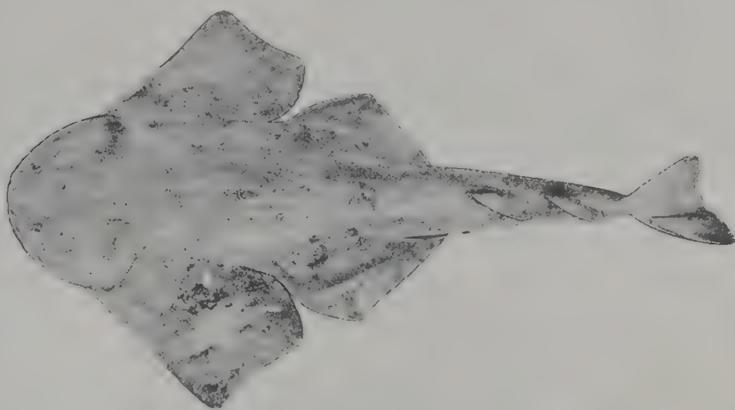


Fig. 23 ***Squatina japonica*** BLEEKER, (× 1/3) original

Body broad, flattened, width of disc equal to one and five eighths total length. Head very broad, flattened; snout very broad, short, obtuse, prjoecting very slightly beyond mandible; eye small, a little closer together than spiracles, directed upward; snout well separated from mouth below by a deep furrow; jaws with about three rows of sharp, pointed teeth, upper projecting slightly beyond mandible; lips rather broad; inferior margin of head with a narrow, thin flap; nostrils closer together than eyes, interorbital space broad, concave, this concavity extending to posterior part of head. Spiracles less than eye. Gill-opening very large, septa with broad dermal laminae crowded togethr before base of pectoral. Above rough, especially alnog edges of dorsal and caudal; a number of small tubercles over eye between nostrils above; lower surface of body perfectly smooth, with exception of anterior borders of pectorals and ventrals and lower surface of tail. Dorsal small, of about equal size, first just behind tips of ventrals, second about midway between origin of first and origin of upper caudal lobe. Pectorals with length of base about one half of length of anterior margin, the latter not equal to breadth of head; ventrals from their origin to tip behind, shorter than anterior edge of pectoral; caudal about half head; tail broad at first, then tapering.

Locality: Mie Prefecture — Owashi.

Distribution: Southern and Middle of Japan.

Order Rajida

Body more or less disk-shaped, rounded or subangular, flattened, with the pectorals fused along the sides of the head. Five gill slits on lower surface. Spiracles usually large. No anal fin. Dorsal fin present or absent. Tail always reduced, sometimes merely a filament. Mouth on lower surface.

Key to Suborders

a[1] Electric organs between head and pectorals. .... **Torpedinina**
a[2] No electric organs between head and pectorals. .... **Rajina**

Suborder Torpedinina

The trunk is broad, smooth disc; tail with rayed dorsal and caudal fins, and a longitudinal fold along each side. Anterior nasal valves confluent into a quadrangular lobe. An electric organ composed or vertical hexagonal tubes between the pectoral fins and the head.

Family **Torpedinidae**

Disc ranging from subcircular to elongate. Tail sector as long as body sector or without lateral folds. Two dorsal fins well developed. Tips of pelvics either separate from sides of tail or united to latter. Eyes eithr well developed, with evident pupil, or obsolete. Nostrils either simple or subdivided by a cross bridge; separate from mouth, but connected by a groove with furrow. Mouth protractile as a short tube and with labial cartilages in others.

Key to Genera

a[1] Tow dorsals. .... **Torpedo**
a[2] One dorsal. .... **Narke**

Genus *Torpedo* HOUTTUYN, 1764

Disc almost circular, front margin flattened. Tow dorsals. Spiracles distinctly back from eyes. Small teeth in a pavement. The pupil is partly covered by a flap of the iris from above.

24. *Torpedo tokionis* (TANAKA). "Yamato-shibire-jei"

Tetronarce tokionis TANAKA, 1908, Journ. Coll. Sci., Tokyo, vol. 23, p. 2, f. Tokyo Market.



Fig. 24 ***Torpedo tokionis*** (TANAKA), from MATSUBARA

Margins of rear parts of pectorals without spinous papilae, the skin naked there, as elsewhere. Rear end of base of first dorsal considerably posterior to rear ends of pelvic fin base. Dorsal surface of disc without conspicuous ocelli though sometimes otherwise blotched or spotted. Margins of spiracles smooth. Disc about as broad as long.

Locality: Mie Prefecture — Owashi.

Distribution: Southern Japan.

Genus *Narke* KAUP, 1826

Head, body, electric organs, and pectorals united in a subcircular disk. Anterior narsal valves confluent in a quardrangular flap, free behind, covering the mouth. Mouth small, protractile, surrounded by a fold. Teeth small, in narrow bands. Eyes small, protruding. Spiracles larger than the eyes, immediately behind the orbits, with smooth, raised edges. Gill-openings narrow. Ventrals broad, distinct, inserted below the pectorals. One dorsal. Tail short, with a fold at each side. Skin soft, smooth, naked.

Key to Species

a[1] Brown above, with white spots and edges, white below. .... **N. dipterygia**
a[2] Brown above and below, plain or spotted with black and white. .... **N. japonica**

25. *Narke dipterygia* (BLOCH et SCHNEIDER). "Hakuten-shibire-jei"

Raia dipterygia SCHNEIDER, 1801, Bloch Ichth., p. 359.
Torpedo dipterygia OLFERS, 1831, Torpedo, p. 25, pl. 2, f. 2.
Narcine dipterygia HENLE, 1834, Über Narcine, p. 38.
Astrope diqterygia MÜLLER et HENLE, 1841, Plagios., p. 131, -T. CANTOR, 1849, Malay Fishes, p. 419.-GRAY, 1851, Chondropterygii, p. 103. -DUMÉRIL, 1852, Rev. and Mag. Zool., p. 42. -1865, Elasm., p. 523. -DAY, 1865, Fishes Malabar, p. 276. -1878, Ind. Fishes, p. 734, pl. 192, f. 4.- GÜNTHER, 1870, Cat. Fishes Brit. Mus., vol. 8, p. 454.

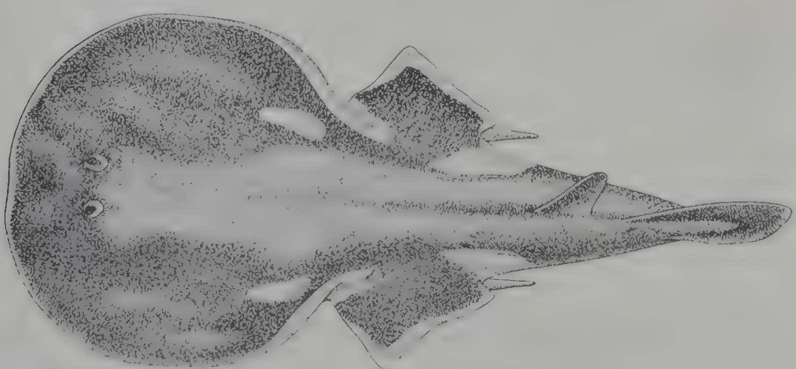


Fig. 25 ***Narke dipterygia*** (BLOCH et SCHNEIDER), from DAY

In most respects closely resembling *Narke japonica*. Distinguished by the ventral fins and the coloration. Disk subcircular; tail little longer. Base of dorsal midway from the bases of the ventrals to the origin of the caudal. Ventrals with an outer angle more or less prominent and with an intended outer

margin. In general it may be said the back is dusky brown, uniform or white-spotted, and the lower surface white with brown blotches or spots.

Locality: Mie Prefecture — Owashi, Kumano-nada.

Distribueion: Japan, China, Indo-China, East Indies.

26. *Narke japonica* (TEMMINCK et SCHLEGEL). "Shibire-jei"

Astrape japonica TEMMINCK et SCHLEGEL, 1805, Fauna Japonica, p. 307, pl. 140; Nagasaki (Japan).

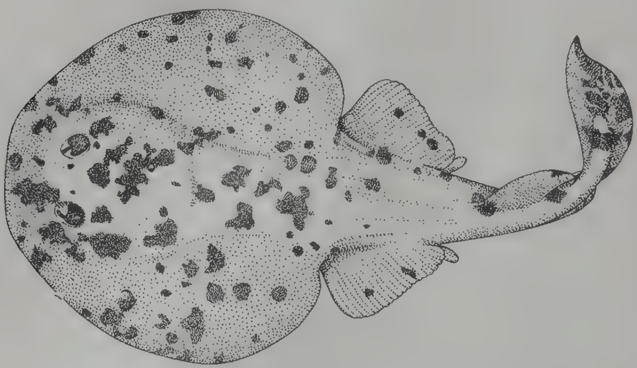


Fig. 26 ***Narke japonica*** (TEMMINCK et SCHLEGEL), (× ca.2/3) from MATSUBARA

Body perfectly smooth, but with many pores, especially along outer portions of pectorals. Disc round and equal to tail, which is broad, compressed, and tapering. Head very small; snout short, equal to space between spiracles; eyes very small four in space between spiracles, nostrils large, rather close together; median flap only separated slightly by a thick frenum; mouth not very broad, about one half width between spiracles, and jaws with flattened pavement-like teeth; interorbital space nearly flat. Spiracles larger than eye, and with their edges elevated. First dorsal, when depressed, reaching base of caudal, and equal to half its length; length of base of ventral is equal to width of caudal at base; tail greatly depressed, broad, and along sides, a rather narrow lateral fold.

Locality: Mie Prefecture — Owashi.

Distribution: Southern and Middle Japan.

Suborder Rajana

This suborder differs from Torpedinina in the following character: No electric organs between head and pectoral fins.

Key to Families

a[1] Tail comparatively robust, with two dorsals and caudal.

b[1] Disc narrow; pectorals extend to side of head, not reaching end of snout. No nasoral grooves. .... **Rhinobatidae**

b[2] Disc broad, rounded; pectorals extend to the end of snout or in the neighbourhood of it.

c[1] Disc rounded; nasoral grooves rudimentary or absent, ventrals not notched; pectorals extend to end of snout, ovo-viviparous or oviparous. .... **Platyrhinidae**

c[2] Disc broad; nasoral grooves present; ventrals notched; pectorals not extend to end of snout; oviparous. .... **Rajidae**

a[2] Tail slender, whiplike, without or with one to three serrated spines; disc broad, polygonal to rounded; ovo-viviparous or oviparous.
d[1] Pectorals uninterrupted, confluent around snout; teeth small, in pavement. ...... **Dasyatidae**
d[2] Pectorals interrupted, one portion forming detached appendages on snout (cephalic fins).
e[1] Teeth few, wide flat morals. .... **Myliobatidae**
e[2] Teeth minute, tubercular, numerous; snout very wide, with two lateral lobes.... **Mobulidae**

Family **Rhinobatidae**

Body depressed, with usually a tapering snout and elongate caudal portion. Trunk gradually passing into the long and strong tail, which is provided with two well-developed dorsal fins, a caudal fin and a conspicuous dermal fold on each side; disc not broad, the rayed portion of the pectoral fins not beeing continued to the snout. The skin nearly smooth. Five gill slits on lower surface. Development viviparous.

Genus *Rhinobatos* LINCK, 1790

Disc longer than wide, usually tapering to a pointed snout. First dorsal well behind pelvics. A flap of the iris projects from above over the pupil. A genus of many closely related moderate sized, sluggish ,bottom-living Rays of shallow water of all warm seas.

27. *Rhinobatos schlegeli* MÜLLER et HENLE. "Sakata-zame"

Rhinobatus schlegelii MÜLLER et HENLE, 1838, Plagios., p. 123, pl. 42; Nagasaki.

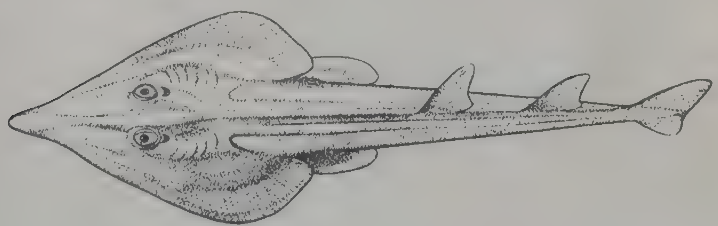


Fig. 27 ***Rhinobatos schlegeli*** (MÜLLER et HENLE), (× 1/12) from MATSUBARA

Body smooth, a single series of small projection down middle of back. Snout pointed; two skinny projections from behind margin of spiracle. Color variable gray to brown.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Southern Japan, Formosa, Korea, Philippines, Arabia.

Family **Platyrhinidae**

Disc large, wide, circular. Tail rather slender, axis not raised, fold along each side. Snout broad, blunt. Nostrils nearly transvers; nasoral grooves rudimentary or absent. Dorsals two, far behind ventrals. Caudal moderately long, subcaudal without lobe and nearly equals supracaudal. Pectorals wide, rounded, extend forward to snout end. Claspers unsegmented. Development oviparous or viviparous.

Genus *Platyrhina* MÜLLER et HENLE, 1838

Body rough, with spine above. Disc rhombic, snout rounded in front; tail very distinct, with a fold on either side, and with two dorsals and a well developed caudal. Pectoral fins united in front, forming for part of snout. Ventral fins separate.

28. *Platyrhina sinensis* (BLOCH et SCHNEIDER). "Uchiwa-zame"

Raie chinoise LACÉPÈDE, Hist. Nat. Poiss., vol. 1, p. 34, 157, pl. 2, f. 2.
Rhina sinensis BLOCH et SCHNEIDER, 1801, Syst. Ichth., p. 352 (after LACÉPÈDE).
Platyrhina sinensis MÜLLER et HENLE, 1838, Plagios., p. 125, pl. 43; Nagasaki. –SCHLEGEL, 1850, Fauna Japonica, p. 307 (no description). –DUMÉRIL, 1870, Elasm., p. 576; Cochin China. –GÜNTHER, 1870, Cat. Fish., vol. 8, p. 471; China.

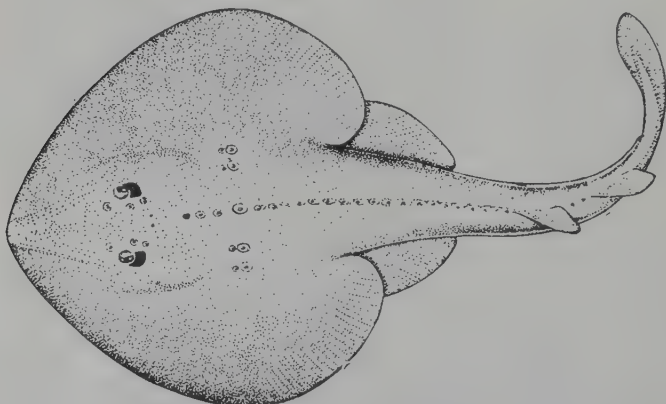


Fig. 28 ***Platyrhina sinensis*** (× 1/2) (BLOCH et SCHNEIDER), from MATSUBARA

Disc very broad, much broader than long. Head greatly flattend; snout confluent with pectorals; eyes small; mouth nearly straight; teeth numerous, small, and flattened, or molar-like; nostrils large, oblique toward mouth, and either equal to space between; interorbital space flattened, even a trifle concave, and a supraoral ridge on each side, somewhat broad; spiracles directly behind eye, and rather round and deep. Gill-openings small. Upper surface of body very rough with small prickles; several small bucklers over eye in front, and over the spiracles; several bucklers on each side of the body near the base of pectoral; lower surface of the body very finely roughened. Dorsal small and posterior on tail, and posterior a little larger; origin of first dorsal nearer that of ventrals than tip of caudal; second dorsal a short distance from first, its origin a little nearer tip of ventral than tip of caudal; pectorals very broad, and with snout from a very blunt angle in front; space between ventrals below greater than snout; caudal equal to snout and eye. Sides of tail below, with a fold on each side, running from ventrals to caudal. Caudal peduncle very short.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: South of middle Honshu (Japan); China Sea.

Family **Rajidae**

Body with disc broad, rhombic, more or less spinous or rough; tail stout, rather

long, with a longitudinal fold on each side, the skin commonly rough with a spines; usually two dorsal fins and sometimes a caudal fin present on the tail; pectoral fins extending to the snout; ventrals large; no serrated spine on tail. Oviparous, the eggs laid in large leathery egg-cases, four angled, with two long tubular horns at end.

Genus *Raja* LINNÉ., 1758

Body with disc partly circular or quadrangular. Snout more or less produced, pointed, with snout prolongation from skull as rostral cartilage. Eyes prominent, with fimbriate velum pupil. Mouth transverse, nearly straight. Teeth small, tessellate, varying from flat to sharp and pointed. Nostrils with two valves, front one broad and reaches mouth, posterior folded in tube. Nasal groove present. Gill-openings small. Spiracles close to eye. Skin usually more or less spiny. Male usually with patch or erectile spines on each side ofpectoral above. Tail very distinct from disc, with fold along each side. Two rayed dorsal fins on tail above. Caudal membranous, rudimentary or absent. Pectoral fins widely separated at snout, not confluent. Ventrals notched.

Key to Species

a[1] Lower surface of disc dark or at least partly dark. .... **R. fusca**
a[2] Lower surface of disc pale or whitish. .... **R. kenojei**

29. *Raja fusca* GARMAN. "Kuro-kasube"

Raja fusca GARMAN, 1855, Proc. U. S. Nat. Mus., p. 42. Japan.

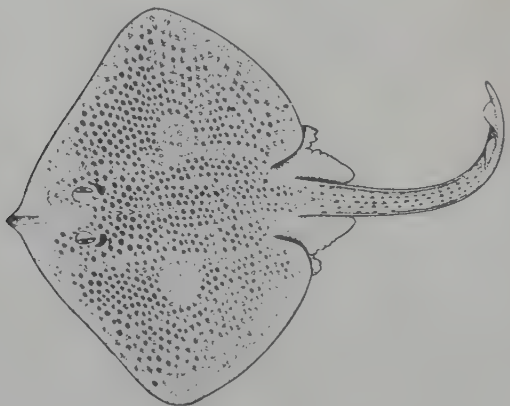


Fig. 29 ***Raja fusca*** GARMAN, (×15) from MATSUBARA

Disc three fourths as long as wide. Snout moderately prominent. Tail from vent equals the length of the disc including the ventrals; depressed, rather broad at the dorsals, behind which it extends in a long point that probably is much reduced in comparative length in the adult. Teeth in three series.

Eyes moderate; interorbital spaces nearly half distance from the end of the snont. Month broad, with a slight forward curve. A pair of large spines in front of each eye; a single spine above each spiracle; one behind the head on the anterior end of the vertebral column, sometimes a second behind this on the shoulder girdle, and a median row on the tail, beginning behind the vent and reaching the second dorsal. Dorsals separated by two spines. Excepting these spines, the back is smooth. Light reddish brown; a black ring, half as wide as the mouth, incloses a light colored space near the shoulder girdle on each pectoral.

Locality: Mie Prefecture — Owashi. Tsu.

Distribution: Pacific coasts of Japan.

30. *Raja kenojei* MÜLLER et HENLE. "Gangi-jei"

Raja Kenojei MÜLLER et HENLE, 1841, Plagios., p. 149, pl. 48, Nagasaki.
Raja japonica NYSTRÖM, 1887, Kongl. Svensk. Vet. Ak., p. 52. Nagasaki.



Fig. 30 ***Raja kenojei*** MÜLLER et HENLE, (×3/10) from MATSUBARA

Body rhomboid, very broad; anterior margin of disc full, slightly undulated, and eyes nearer to it than their space between; mouth large, slightly undulate; teeth in about forty-five rows in upper jaw, small, rounded; nostrils very large, broadly separated, but not equal to width of mouth at its corners, with which it is also confluent; nasal flaps large, posterior margin fringed; length of nostril to corner of mouth equal to two and one half in space between latter and tip of snout; interorbital space concave, though flattened in middle, and supraorbital ridges little elevated. Spiracles rather large, a little smaller than eye, oblique, directly posterior. Gill-openings very small. Body almost perfectly smooth, with exception of some roughness on snout, several small tubercles on supraorbital ridge, one in center of back in front, and five irregular rows of thorns on back of tail. Dorsals separated, distance with about one sixth base of first; second dorsal confluent with small caudal, only separation a deep notch, and equal to first dorsal in size; angle of pectoral would fall at about middle of length of disc; ventrals moderate. Color in spirits, brown above, whitish beneath; upper surface marked small, blackish spots; at base of pectorals, two large, blackish rings above, below which though farther apart, also two indistinct, imperfect rings, and still posterior on last rays, a small, black spot; nine indistinct, blackish cross-bands on upper surface of tail; lower surface of bdy whitish, soiled with brown, pores with grayish borders.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Coasts of Japan, Eastern China Sea.

Family **Dasyatidae**

A flat, rather lozenge shaped disc, the front margins usually straight, not undulated. A long tail with usually a serrated spine well behind the base. No dorsal fin. Teeth small, in pavement. Spine with two longitudinal grooves on each side, connected poison-glands.

Key to Genera

a[1] Disc about wide as long. Tail long. .... **Dasyatis**
a[2] Disc broader than long. Tail short. .... **Gymnura**

Genus *Dasyatis* RAFINESQUE, 1810

Disc partly quadrangular to partly circular, flat, edges rounded. Teeth small, paved. Usually a few papillae inside mouth behind lower jaw. Skin generally more or less rough with spines or tubercles, rarely smooth, or smooth in young and becoming rough with age. Tail long and whip like, with serrated caudal spine, with or without dermal fin folds or keels behind spine, and without lateral folds on base.

31. *Dasyatis akajei* (MÜLLER et HENLE). "Aka-jei"

Trygon akajei MÜLLER et HENLE, 1838, Plagios., p. 165, pl. 53. Ngasaki.



Fig. 31 ***Dasyatis akajei*** (MÜLLER et HENLE), (× 1/4) from MATSUBARA

Disc broadly oval, Head moderate, snout produced into a short, produced through very blunt point, and anterior edge of disc very broadly convex; eyes small, elavated a little, and five in interorbiral space; nostrils large, confluent except for the thick, cartilaginous frenum; mouth small, more than one half snout; teeth flattened, pavement-like; lower lip with narrow folds; interorbital space broad, flat. Spiracles not quite twice eyes. Body smooth, except a patch of asperities between and posterior to each eye, and a median series on back, developing posteriorly, into large thorny spines to caudal spine; end of tail rough; rest of body perfectly smooth. Base of ventral less than interorbital space; tail much longer than disc, tapering rapidly till very slender, its width at base more than half interorbital space; spine on upper part of tail inserted a little before first third of its length, longer than snout, and serrate on both edges, on outer half; a small keel on tail above, behind spine, and a long one runs along lower surface. Color in alcohol dark, dusty brown above, be-

coming lighter on outer and marginal portions of disc; lower surface of body a creamy white; a creamy buff bar in front of and below eye, also another about spiracles, above and at corners; sides of tail whitish, also edges of claspers. The belly is more or less bright orange red in life.

Locality: Mie Prefecture — Tsu.

Distribution: Southern Japan, Korea, China.

Genus *Gymnura* KUHL, 1823

Disc much broader than long, its anterior margins meeting in a very obtuse angle, its outer angles more or less acute, the form, therefore, transversely rhombic. Tail very short and slender, shorter than the disc, without fin, armed with a very small, serrated spine, which is often wanting. Skin smooth, or very nearly so. Size rather large. Viviparous.

32, *Gymnura japonica* (TEMMINCK et SCHLEGEL). "Tusbakuro-jei"

Pteroplatea japonica SCHLEGEL, 1850, Fauna Japonica, Poiss., p. 309, pl. 141; Nagasaki. –BLEEKER, 1857, Act. Soc. Sci. Indo. Neerl., vol. 3, p. 45, Japan; –DUMÉRIL, 1870, Elasm., p. 614.
Dasyatis micrura var. *japonicus* GRAY, 1851, Chondropt., p. 122; Japan, Canton.
Pteroplatea hirundo ISHIKAWA, 1897, Prel. Cat., p. 60; Tokyo, Boshu (Japan).



Fig. 32 ***Gymnura japonica*** (TEMMINCK et SCHLEGEL), (× 1/3) original

Disc very broad, its length only a little more than half its width, its greatest width would fall about opposite last fourth of its length. Head very broad, and flattened; snout only a small, blunt point, and its length equal to two thirds of interorbital space; anterior margin of disc broadly convex; eyes small somewhat elevated. Nostrils large, well separated, with large flaps; mouth moderate, equal to its length from tip of snout, undulate; teeth in broad, pavement-like patches in jaws; interorbital space very broad, flattened. Spiracles directly behind eye, much larger than the same. Gill-openings moderate. Body entirly smooth. Base of ventrals one and three fourths in interorbital space; tail vety small, short, its length about twice interorbital width. Brown above more or less mottled. Tail alternately light and dark.

Locality: Mie Prefecture — Owashi, Tsu.
Distribution: Southern Japan, Korea, China.

Family **Myliobatidae**

Disc broad; the pectoral fins not continued to the end of the snout, but ceasing on the sides of the head and reappearing in front of the snout as one or two fleshy protuberances (cephalic fins), which are supported by fin rays. Tail very long and slender, whip-like, with a sigle dorsal fin near its root, behind which is usually a strong, retrosely serrated spines. Nasal valves forming a rectangular flap, with the posterior margin free, attached by a frenum to the upper jaw. Skull less depressed than usual among rays, its surface raised so that the eyes and spiracles are lateral in position. Teeth hexangular, large, flat, tessellated, the middle ones usually broader than the others, No differentiated spines on the pectorals in the males, the sexes being similar. Ventrals not emarginate. Ovo-viviparous.

Genus *Holorhinus* GILL, 1862

Disc broad, the outer angles acute. Cephalic fins, forming a soft, convex appendage in front of snout. Jaws about equal. Median teeth very broad, much broader than long in the adult, proportionally narrower in the young. Several series of narrower teeth on each side of the median series; teeth changing considerably with age. Free edge of the nasal valve not deeply emarginate. Tail very long and slender, with a small dorsal fin, and one or more serrated spines. Skin smooth, or nearly so. Size large.

33. *Holorhinus tobijei* (BLEEKER). "Tobi-jei"



Fig. 33 ***Holorhinus tobijei*** (BLEEKEER) (× 1/10) original

Myliobatis aquila SCHLEGEL, 1847, Fauna Japonica, p. 310, 142; Nagasaki (not of LINNÉ).
Myliobatis tobijei BLEEKER, 1854, Verh. Bat. Gen., vol. 26, Nieuwe Nalez. Japan, p. 130, Nagasaki. -DUMÉRIL, 1870, Elasm. p. 640 (after BLEEKER).
Myliobatis cornuta GÜNTHER, 1870, Cat. Fish, vol. 8, p. 490; Japan. -ISHIKAWA, 1897, Prel. Cat., p. 60; Matsushima (Japan).

Disc very broad, length of body from tip of snout to tip of ventral a little more than one and a half in its greatest width. Head thick, depressed and rounded above; snout flexible, inferior, flattened, and rounded; eyes small, lateral, at some distance in advance of spiracles; nostrils large, rather close together, separated by thick, cartilaginous and fleshy frenum, which is coarsely papillose or warty; lips and nasal flaps very thick and fleshy; teeth in pavement-like plates; interorbital space broad, fontanelle hollow in middle, and on each sides of this a little elevated and flattened. Spiracles large, oblique. Gill-opening moderate. Body smooth. Dorsal fin small, its base a little less than length of spiracle, inserted behind ventrals; caudal very long, filamentous; upper surface of tail with a compressed, pointed spine with serrated edges a little less in length than space between spiracles; ventrals long and free, bases rather narrow. Color in alcohol, dusky brown above, with many rather large, whitish spots, distinct posteriorly; lower surface chalky white; tail blackish.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Shores of Japan, Korea, China.

Family **Mobulidae**

Disc much wider than long, rhomboid, the pectoral tips falcate. On each side of the snout is a fleshy projection, a cepgalic fin or horn, separated by the width of the mouth, the latter either terminal or below the head. Teeth minute. The intestinal canal is so made that only fine materials can pass through the stomach, and these creatures feed mainly upon minute organism strained from the water. Tail thin, whiplike, sometimes with basal spine.

Genus *Mobula* RAFINESQUE, 1810

Head free from pectoral fin, truncate in front, with cephalic fin on each side developed as a straight, horn-like appendage, pointing forward. Nostrils widely separated. Mouth below head. Teeth in both jaws minute, flat, or tubercular, in many series. Tail very slender, with a dorsal fin between the ventrals; the serrated spine present or absent. Small dorsal fin present.

34. *Mobula joponiac* (MÜLLER et HENLE). "Itomaki-jei"

Cephaloptera japonica MÜLLER et HENLE, 1836, Plagios., p. 185; Nagasaki. -SCHLEGEL, 1850, Fauna Japonica, p. 310; Nagasaki. -DUMÉRIL, 1870, Elasm. p. 659 (after MÜLLER et HENLE).
Dicerobatis japonica GÜNTHER, 1870, Cat. Fish, vol. 8, p. 496 (after MÜLLER et HENLE).

Teeth very minute, obtuse tubercles, extending laterally of the angles of the mouth. Back rough. Tail nearly thrice as long as body. On each side of tail, a series of small white tubercles.

Locality: Mie Prefecture — Owashi, Tsu.

Distribution: Coasts of Japan, Korea, China

Subclass Holocephali

Body massive, compressed. Tail and caudal region attenuated. Upper jaws and other palatal cartilages joined with skull. Dental plates in three pairs, vomerine

and palatine above, mandibular below. Opercles rudimentary. One gill-opening each side of pharynx, contains four gill clefts and four gills united with skin terminally. No spiracles, except in embryonic stages. Skull without system of membrane bones, as opercles, etc. Skeleton cartilaginous. No distinct suspensorial cartilage for

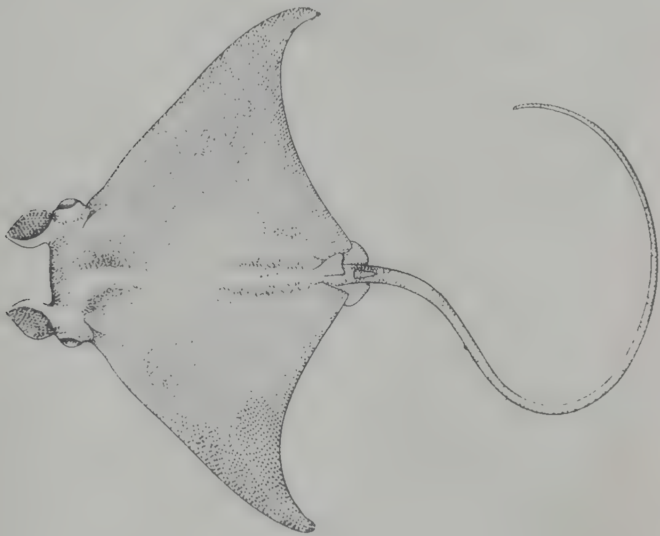


Fig. 34 ***Mobula japonica*** (MÜLLER et HENLE), (× ca. 2/3) from JORDAN et FOWLER

lower jaw. Vertebrae imperfect, coalescent anteriorly. Brain massed posteriorly, more distributed forward, hemispheres distant from optic lobes and attached to them by nerve-like thread. Intestine with spiral valve. Skin naked, muciferous system highly developed. Dorsal fin erectile, with spine. Pectorals normal, low. Ventrals abdominal. Mature males with erectile frontal tentacle and prepelvic claspers.

Order Chimaerida

Skeleton cartilaginous. Gill cavity with four clefts within, but having one external opening only, which is covered by a fold of skin, within which is rudimentary cartilaginous operculum. No spiracles. Mouth inferior. Jaws without separate teeth, but armed with bony plates. Intestines with a spiral valve. No air-bladder. Jaws and plate coalescent with the skull. Derivative radii sessile on the side of the basal bones of the limbs, separated from the articulation. Pectoral fins normally developed, placed low. Ventral fins abdominal. Tail tapering. Skin smooth or nearly so. A single family Chimeridae.

Family **Chimaeridae**

Body elongate, rather robust anteriorly, tapering posteriorly. Head compressed. Mouth inferior. Upper lip deeply notched. Nostrils confluent with the mouth, separated by a narrow isthmus. Jaws with the teeth confluent into four bony laminae above and two below. No spiracles. Males with a peculiar cartilaginous hook, armed with prickles at the tip, and turned forward on the upper part of the snout. Pectoral fins free, placed low. Ventral fins abdominal, many-rayed, provided in the male with claspers. Dorsal fin usually divided; anteriorly with a very strong spine, which is grooved behind. Caudal fin low, fold-like. Skin naked, rarely somewhat prickly. Lateral line present, usally with numerous branches anteriorly. Three free gills and two half gills, one on each side. Isthmus moderate; gill rakers small. Oviparous, the egg cases long, elliptical, with silky filaments.

Key to Genera

a[1] Claspers of male trifid. .... **Chimaera**
a[2] Claspers of male bifid. .... **Phasmichthys**

Genus *Chimaera* LINNÉ, 1758

Head somewhat compressed, the snout bluntish, protruding, fleshly, not armed at tip with an appendage. Eyes very large, lateral. Teeth rather strong. Lips thickish, the lower with a frenum. Lateral line simple on the body, but forking anteriorly, forming several series of mucous tubes on the head. Male with a club-shaped, cartilaginous hook on the head, above the snout. This hook is curved forward and downward, and is armed at its tip with decurved spines. Its tip fits into a depression in front of the eyes. Gill-opening small. Pectorals moderate. Ventrals rather large. Male also with rough appendages at the base of the ventrals, protruding from a sheath of skin. First dorsal triangular, preceded by a strong spine which is grooved behind and serrated on its edges. Second dorsal and caudal fins low, often more or less notched. Tail extending in the line of the axis of the body, sometimes produced in a filament. Skin smooth.

35 *Chimaera phantasma* JORDAN et SNYDER. "Ginzame"

Chimaera monstrosa SCHLEGEL, 1850, Fauna Japonica, Poiss., p. 300, pl. 132; Nagasaki (not of LINNÉ).
Chimaera phantasma JORDAN et SNYDER, 1900, Proc. U. S. Nat. Mus., p. 338; Tokyo.

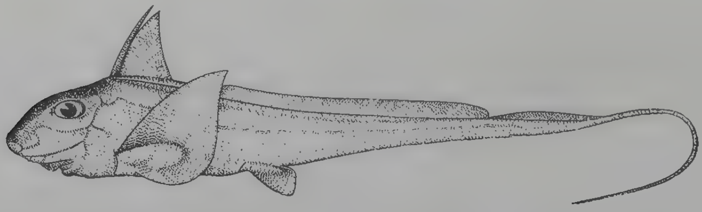


Fig. 35 ***Chimaera phantasma*** JORDAN et SNYDER, (×ca. 1/8) from DEAN

Body compressed. Tail tapering from body cavity to a long filament terminally. Head compressed, subconic. Snout soft, rather blunt. Eye large, lateral. Lateral line in soft wave on flank. First dorsal triangular, close to head, short, deep, preceded by strong erectile spine and followed by low dermal fold. Second dorsal low, not indented on upper edge, reaches above caudal origin. Anal small, rising slowly, separated by a narrow notch from subcaudal. Caudal fins low, rising slowly in front, descending very gradually backward. Pectoral large, reach behind ventral origin, hind edge slightly concave. Ventral far in forward half of total length. Brown, reddish to golden or silver above, more or less clouded and blotched with brown, irregularly scattered or in longitudinal streaks. Fins with dark outer edges.

Locality: Mie Prefecture — Kumano-nada, Owashi.

Distribution: Deep sea of eastern coasts of Japan, Korea, China.

Genus *Phasmichthys* JORDAN and HUBBS, 1925

This genus differs from *Chimaera* LINNÉ in the following characters: Two branched clasper, no anal fin, lack of a notch in the second dorsal and more elongation of terminal filament of caudal fin.

36. *Phasmichthys mitsukurii* (DEAN). "Aka-ginzame"

Chimaera mitsukurii DEAN, 1904, Journ. Coll. Sci. Tokyo, vol. 19, art. 3, p. 6, pl. 1, f. 1–2, Misakl, Sagami (Japan). -JORDAN et SNYDER, 1904 Proc, U. S. Nat. Mus., vol. 27, p. 234, f. 2, Sagami (Japan). -GARMAN, 1911, Mem. Mus. Comp. Zool., vol. 40, p. 87, Sagami. -IZUKA et MATSUMURA, 1920, Cat. Zool. Spec. Tokyo Mus. Vertebrata, p. 186, Misaki.

Phasmichthys mitsukurii JORDAN et HUBBS, 1925, Mem. Carnegie Mus., vol. 10, p. 119, Misaki.

Chimaera phantasma (not JORDAN et SNYDER) JORDAN et FOLWER, 1609, Proc. U. S. Nat. Mus., vol. 26, p. 669, Sagami.



Fig 36 ***Phasmichthys mitsukurii*** (DEAN),(× 1/3) original

Snout obtusely convex, mouth below front of eye. Lateral line somewhat irregular, not waved; jugular section meets angular short space below junction of orbit and angular. Dorsal spine long as head, inserted over hind edges of gill-opening, front and hind edges serrated, connected with second dorsal by low fold. Anal not distinct; caudal filament slightly over twice in rest of body; pectoral reaches middle of ventral base. Blackish above, with here and there clouded light area, below dark sepia. Ventral fins nearly black, somewhat paler basally. Bluish tint on front rim of ventral.

Locality: Mie Precture — Kumano-nada.

Distribution: Deep sea of Sagami Bay, Suruga Bay, Kishu and Kochi (Japan).

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